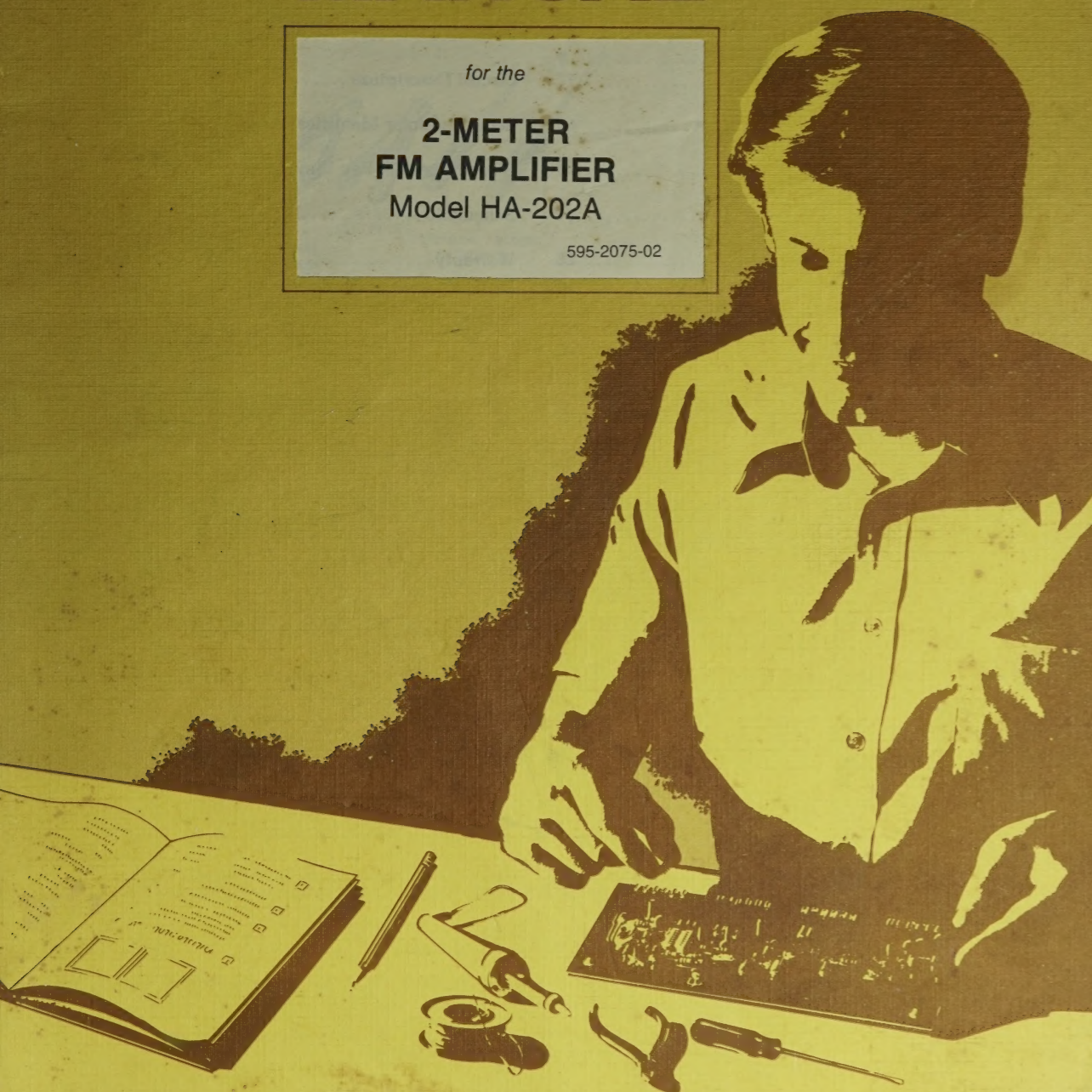


HEATHKIT[®] MANUAL

for the

2-METER FM AMPLIFIER Model HA-202A

595-2075-02



HEATH COMPANY • BENTON HARBOR, MICHIGAN

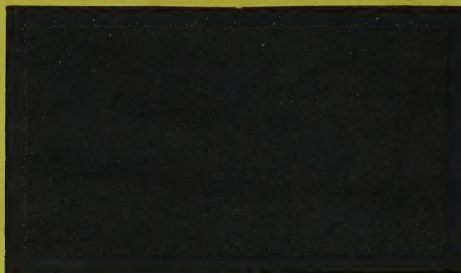
HEATH COMPANY PHONE DIRECTORY

The following telephone numbers are direct lines to the departments listed:

Kit orders and delivery information (616) 982-3411
Credit (616) 982-3561
Replacement Parts (616) 982-3571

Technical Assistance Phone Numbers

8:00 A.M. to 12 P.M. and 1:00 P.M. to 4:30 P.M., EST, Weekdays Only
R/C, Audio, and Electronic Organs (616) 982-3310
Amateur Radio (616) 982-3296
Test Equipment, Weather Instruments and
Home Clocks (616) 982-3315
Television (616) 982-3307
Aircraft, Marine, Security, Scanners, Automotive,
Appliances and General Products (616) 982-3496
Computers (616) 982-3309



YOUR HEATHKIT 90-DAY LIMITED WARRANTY

For a period of ninety (90) days after purchase, Heath Company will replace or repair free of charge any parts that are defective either in materials or workmanship. You can obtain parts directly from Heath Company by writing us at the address below or by telephoning us at (616) 982-3571. And we'll pay shipping charges to get those parts to you — anywhere in the world.

We warrant that during the first ninety (90) days after purchase, our products, when correctly assembled, calibrated, adjusted and used in accordance with our printed instructions, will meet published specifications.

If a defective part or error in design has caused your Heathkit product to malfunction during the warranty period through no fault of yours, we will service it free upon proof of purchase and delivery at your expense to the Heath factory, any Heathkit Electronic Center, or any of our authorized overseas distributors.

You will receive free consultation on any problem you might encounter in the assembly or use of your Heathkit product. Just drop us a line or give us a call. Sorry, we cannot accept collect calls.

Our warranty does not cover and we are not responsible for damage caused by: incorrect assembly, the use of corrosive solder, defective tools, misuse, or fire; or by unauthorized modifications to or uses of our products for purposes other than as advertised. Our warranty does not include reimbursement for inconvenience, loss of use, customer assembly or set-up time.

This warranty covers only Heathkit products and is not extended to allied equipment or components used in conjunction with our products. **We are not responsible for accidental or consequential damages.** Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

If you are not satisfied with our service (warranty or otherwise) or with our products, write directly to our Director of Customer Services, Heath Company, Benton Harbor, Michigan 49022. He will make certain your problems receive immediate, personal attention.

HEATH COMPANY
BENTON HARBOR, MI. 49022

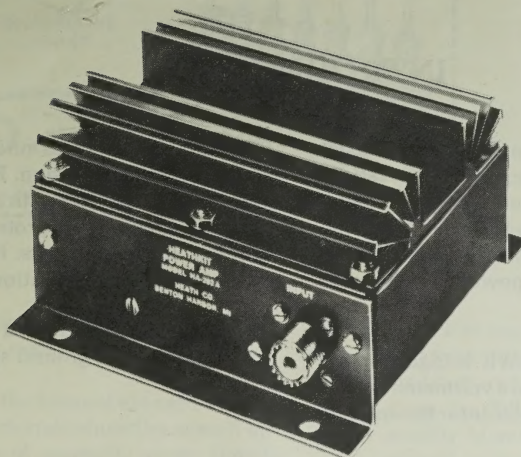
The Heath Company reserves the right to discontinue products and to change specifications at any time without incurring any obligation to incorporate new features in products previously sold.

Heathkit® Manual

for the

2-METER FM AMPLIFIER Model HA-202A

595-2075-02



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BENTON HARBOR, MICHIGAN 49022

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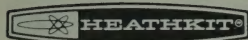
INTRODUCTION

The Heathkit Model HA-202A Amplifier is a compact 2-meter amplifier designed for mobile FM operation. It is intended for use with a transmitter or transceiver capable of supplying 5 to 15 watts of FM driving power. The output power of this Amplifier will be 20 to 50 watts, depending on the power level used to drive it.

You should use a wattmeter (SWR bridge) for the alignment. However, you may use a voltmeter. A 50 Ω noninductive load should be available for the antenna connector.

This Amplifier features automatic antenna switching and all solid-state design. Rugged, emitter-ballasted transistors, combined with an efficient heat sink, provide adequate VSWR protection without the use of complex sensing circuits. Hardware and connectors are supplied for installation.

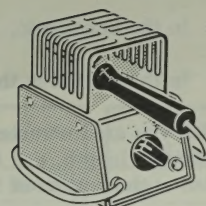
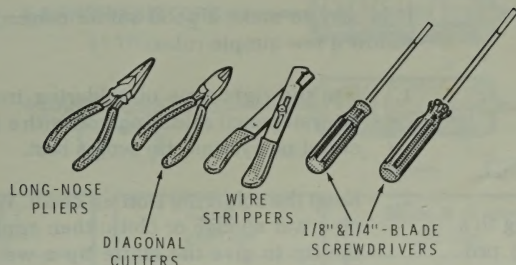
The Amplifier is designed for operation from a 12-volt DC, negative ground system.



ASSEMBLY NOTES

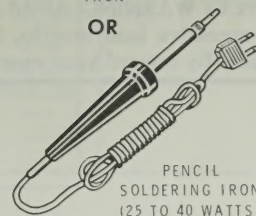
TOOLS

You will need these tools to assemble your kit.



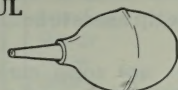
HEATHKIT
SOLDERING
IRON

OR

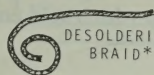


PENCIL
SOLDERING IRON
(25 TO 40 WATTS)

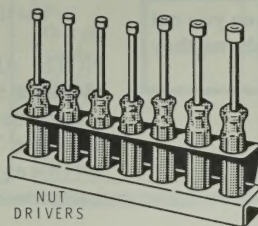
OTHER HELPFUL TOOLS



DESOLDERING
BULB*



DESOLDERING
BRAID*



NUT
DRIVERS



NUT STARTER
(MAY BE SUPPLIED
WITH KIT)

*TO REMOVE SOLDER FROM CIRCUIT CONNECTIONS.

ASSEMBLY

1. Follow the instructions carefully. Read the entire step before you perform each operation.
2. The illustrations in the Manual are called Pictorials and Details. Pictorials show the overall operation for a group of assembly steps; Details generally illustrate a single step. When you are directed to refer to a certain Pictorial "for the following steps," continue using that Pictorial until you are referred to another Pictorial for another group of steps.
3. Most kits use a separate "Illustration Booklet" that contains illustrations (Pictorials, Details, etc.) that are too large for the Assembly Manual. Keep the "Illustration Booklet" with the Assembly Manual. The illustrations in it are arranged in Pictorial number sequence.
4. Position all parts as shown in the Pictorials.
5. Solder a part or a group of parts only when you are instructed to do so.

6. Each circuit part in an electronic kit has its own component number (R2, C4, etc.). Use these numbers when you want to identify the same part in the various sections of the Manual. These numbers, which are especially useful if a part has to be replaced, appear:

- In the Parts List,
- At the beginning of each step where a component is installed,
- In some illustrations,
- In the Schematic,
- In the section at the rear of the Manual.

7. When you are instructed to cut something to a particular length, use the scales (rulers) provided at the bottom of the Manual pages.

SAFETY WARNING: Avoid eye injury when you cut off excessive lead lengths. Hold the leads so they cannot fly toward your eyes.

SOLDERING

Soldering is one of the most important operations you will perform while assembling your kit. A good solder connection will form an electrical connection between two parts, such as a component lead and a circuit board foil. A bad solder connection could prevent an otherwise well-assembled kit from operating properly.

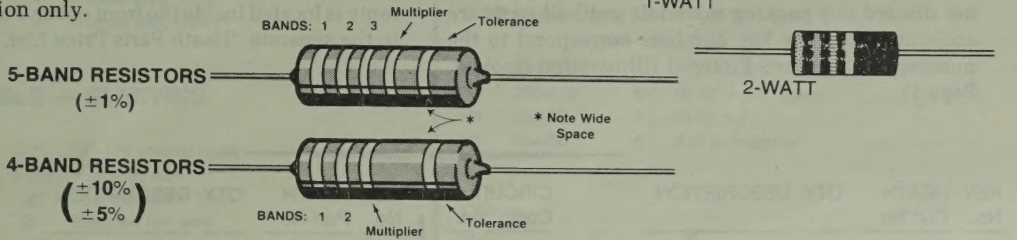
It is easy to make a good solder connection if you follow a few simple rules:

1. Use the right type of soldering iron. A 25 to 40-watt pencil soldering iron with a 1/8" or 3/16" chisel or pyramid tip works best.
2. Keep the soldering iron tip clean. Wipe it often on a wet sponge or cloth; then apply solder to the tip to give the entire tip a wet look. This process is called tinning, and it will protect the tip and enable you to make good connections. When solder tends to "ball" or does not stick to the tip, the tip needs to be cleaned and retinned.

NOTE: Always use rosin core, radio-type solder (60:40 or 50:50 tin-lead content) for all of the soldering in this kit. This is the type we have supplied with the parts. The Warranty will be void and we will not service any kit in which acid core solder or paste has been used.

PARTS

Resistors will be called out by their resistance value in Ω (ohms), $k\Omega$ (kilohms), or $M\Omega$ (megohms). Certain types of resistors will have the value printed on the body, while others will be identified by a color code. The colors of the bands and the value will be given in the steps, therefore the following color code is given for information only.



Band 1 1st Digit		Band 2 2nd Digit		Band 3 (if used) 3rd Digit		Multiplier		Resistance Tolerance	
Color	Digit	Color	Digit	Color	Digit	Color	Multiplier	Color	Tolerance
Black	0	Black	0	Black	0	Black	1	Silver	$\pm 10\%$
Brown	1	Brown	1	Brown	1	Brown	10	Gold	$\pm 5\%$
Red	2	Red	2	Red	2	Red	100	Brown	$\pm 1\%$
Orange	3	Orange	3	Orange	3	Orange	1,000		
Yellow	4	Yellow	4	Yellow	4	Yellow	10,000		
Green	5	Green	5	Green	5	Green	100,000		
Blue	6	Blue	6	Blue	6	Blue	1,000,000		
Violet	7	Violet	7	Violet	7	Silver	0.01		
Gray	8	Gray	8	Gray	8	Gold	0.1		
White	9	White	9	White	9				

Capacitors will be called out by their capacitance value in μF (microfarads) or pF (picofarads) and type: ceramic, Mylar*, electrolytic, etc. Some capacitors may have their value printed in the following manner:

EXAMPLES:

$$151K = 15 \times 10 = 150 \text{ pF}$$

$$759 = 75 \times 0.1 = 7.5 \text{ pF}$$

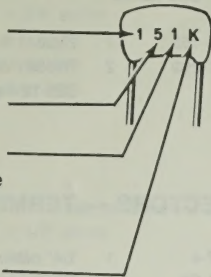
NOTE: The letter "R" may be used at times to signify a decimal point: as in: 2R2 = 2.2 (pF or μF).

First digit of capacitor's value: 1

Second digit of capacitor's value: 5

Multiplier: Multiply the first & second digits by the proper value from the Multiplier Chart.

To find the tolerance of the capacitor, look up this letter in the Tolerance columns.



MULTIPLIER		TOLERANCE OF CAPACITOR		
FOR THE NUMBER:	MULTIPLY BY:	10 pF OR LESS	LETTER	OVER 10 pF
0	1	$\pm 0.1 \text{ pF}$	B	
1	10	$\pm 0.25 \text{ pF}$	C	
2	100	$\pm 0.5 \text{ pF}$	D	
3	1000	$\pm 1.0 \text{ pF}$	F	$\pm 1\%$
4	10,000	$\pm 2.0 \text{ pF}$	G	$\pm 2\%$
5	100,000		H	$\pm 3\%$
			J	$\pm 5\%$
8	0.01		K	$\pm 10\%$
9	0.1		M	$\pm 20\%$

*DuPont Registered Trademark

PARTS LIST

Check each part against the following list. Any part that is packed in an individual envelope with the part number on it should be placed back in the envelope after you identify it until it is called for in a step. Do not discard any packing materials until all parts are accounted for. The key numbers correspond to the numbers on the Parts Pictorial (Illustration Booklet, Page 1).

To order a replacement part, always include the PART NUMBER. Use the Parts Order Form furnished with this kit. If one is not available, see "Replacement Parts" inside the rear cover of the Manual. Your Warranty is located inside the front cover. For prices, refer to the separate "Heath Parts Price List."

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
---------	----------------	------	-------------	-------------------

RESISTORS (1/2-Watt, 5%)

A1	6-100	2	10 Ω (brown-black-black)	R1, R2
A1	6-102	2	1000 Ω (brown-black-red)	R3, R4*
A1	6-272	1	2700 Ω (red-violet-red)	R4*
A1	6-472	1	4700 Ω (yellow-violet-red)	Test

CAPACITORS

Mica

B1	20-198	2	5 pF	C19, C21
B1	20-130	2	12 pF	C22, C24
B1	20-99	3	22 pF	C12, C13
				C14
B1	20-100	1	30 pF	C23
B1	20-101	6	47 pF	C4, C5,
				C6, C7,
				C8, C9
B1	20-76	1	68 pF	C3

Ceramic

B2	21-149	2	2.7 pF	C18,
				Test
B2	21-140	1	.001 μ F	C17
B2	21-48	1	.05 μ F	C11

Other

B3	25-834	1	22 μ F tantalum	C25
B4	31-87	4	Trimmer (12-55 pF)	C1, C2,
				C15, C16

*Only one of the two resistors listed for R4 will be installed. The value used will depend on the type number supplied for transistor Q1 and Q2.

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
---------	----------------	------	-------------	-------------------

INDUCTORS

C1	40-1928	2	22 nH coil (brown)	L11, L14
C2	40-1927	2	56 nH coil (red)	L12, L13
C3	45-74	1	.47 μ H RF choke	L9

DIODES — TRANSISTORS

D1	56-56	2	1N4149 diode	D1, D2
----	-------	---	--------------	--------

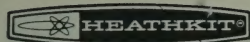
NOTE: Transistors are marked for identification in one of the following four ways.

1. Part number.
2. Transistor type number.
3. Part number and transistor type number.
4. Part number with a transistor type other than the one listed.

D2	417-155	1	2N3641 transistor	Q3
D3	417-299	2	2N5591 or B25-12 transistor	Q1, Q2

CONNECTORS — TERMINALS — CLAMPS

E1	207-4	1	1/4" cable clamp
E2	431-70	1	Terminal strip
E3	432-72	2	Male terminal
E4	432-73	2	Female terminal
E5	432-121	8	Connector pin (includes 2 extra)



KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
------------	-------------------	------	-------------	----------------------

E6	432-137	1	1/4" push-on connector	
E7	432-720	1	Male terminal housing	
E8	432-723	1	Female terminal housing	
E9	436-5	2	Coaxial jack	
E10	438-9	2	Coaxial plug	
E11	438-12	2	Coaxial plug insert	

WIRE — CABLE — SLEEVING

343-12	2'	RG-174 coaxial cable
340-1	1-1/2'	#14 solid wire
344-7	20'	Stranded black wire
344-118	20'	Stranded red wire
346-1	6"	Sleeving

METAL PARTS

F1	200-1319-1	1	Cover
F2	202-621-1	1	Right side chassis
F3	202-620-1	1	Left side chassis
F4	205-1407	2	Spacer strip
F5	215-66	1	Heat sink

Hardware

NOTE: The hardware may be in more than one packet. Open all the hardware packets according to their size before you check the hardware.

Hardware is shown actual size. To identify a piece of hardware, place it over the illustration.

#4 Hardware

G1	250-273	8	4-40 × 3/8" screw
G2	252-99	8	4-40 nut
G3	254-34	6	#4 lockwasher
G4	259-9	2	#4 solder lug

#6 Hardware

G5	250-237	9	#6 × 3/8" sheet metal screw
G6	250-234	4	6-32 × 1/2" screw
G7	252-77	4	6-32 nut
G8	254-25	3	#6 lockwasher
G9	259-1	1	#6 solder lug

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
------------	-------------------	------	-------------	----------------------

#8 Hardware

H1	252-78	4	8-32 nut
----	--------	---	----------

#10 Hardware

H2	250-239	4	#10 × 3/8" sheet metal screw
H3	250-443	6	10-32 × 1/2" screw
H4	252-63	6	10-32 nut
H5	254-36	6	#10 lockwasher

Other

H6	253-89	1	"D" washer
H7	259-22	2	Spade solder lug

MISCELLANEOUS

J1	69-91	1	Relay	RL1
	85-2125-2	1	Circuit board	
J2	205-778	1	1" steel blade	
J3	253-28	2	White "O" ring	
J4	260-16	2	Alligator clip	
J5	261-1	4	Rubber foot	
J6	352-13	1	Silicone grease	
J7	421-4	2	Fuse, 8A, 3AG, (1 spare)	
J8	422-1	1	Fuse block	
J9	475-12	2	Ferrite bead	
J10	490-5	1	Nut starter	
J11	490-112	1	Extractor tool	
J12	490-168	1	5/16" × 1/4" wrench	

Solder

PRINTED MATERIAL

391-34	1	Blue and white label
597-260	1	Parts Order Form
	1	Assembly Manual (See Page 1 for part number.)

CIRCUIT BOARD ASSEMBLY

The steps performed in this Pictorial are in this area of the circuit board.

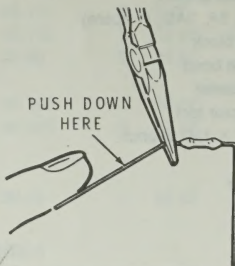
START

- () Refer to the identification drawing at the top of this page and position the circuit board as shown with the lettered side up. Then complete each step in the following Pictorials.

NOTE: In the following steps, you will be given detailed instructions on how to install and solder the first part on the circuit board. Read and perform each step carefully. Then use the same procedure whenever you install parts on the circuit board.

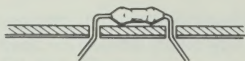
- ✓ Position the circuit board as shown.

- ✓ R3: Hold a 1000 Ω (brown-black-red) resistor as shown and bend the leads straight down with long-nose pliers to fit the hole spacing on the circuit board.

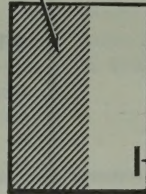


- () Push the leads through the holes at the indicated location on the circuit board. The end with color bands may be positioned either way.

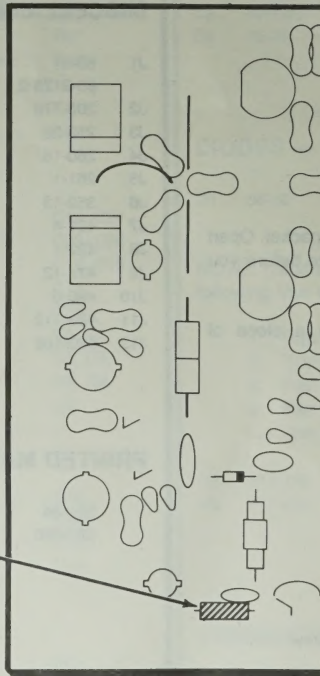
- () Press the resistor against the circuit board. Then bend the leads outward slightly to hold the resistor in place.



IDENTIFICATION
DRAWING



PART
NUMBER

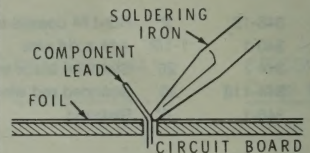


PICTORIAL 1-1

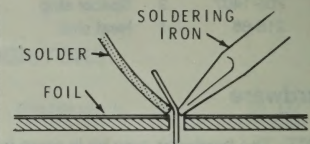
CONTINUE

- () Solder the resistor leads to the circuit board as follows:

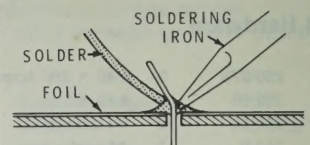
1. Push the soldering iron tip against both the lead and the circuit board foil. Heat both for two or three seconds.



2. Then apply solder to the other side of the connection. IMPORTANT: Let the heated lead and the circuit board foil melt the solder.



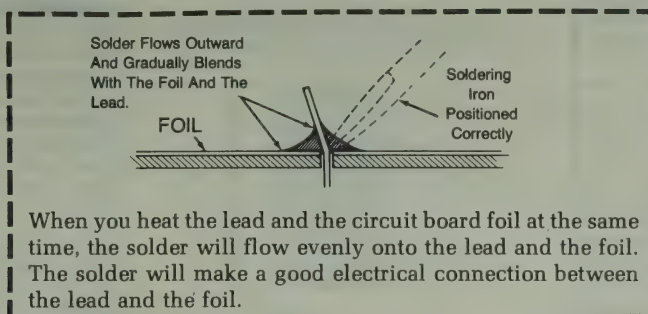
3. As the solder begins to melt, allow it to flow around the connection. Then remove the solder and the iron and let the connection cool.



- () Cut off the excess lead lengths close to the connection. WARNING: Clip the leads so the ends will not fly toward your eyes.

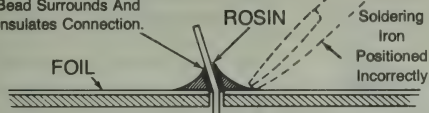
Check the connection. Compare it to the illustrations on the next page. After you have checked the solder connections, proceed with the assembly on Page 10. Use the same soldering procedure for each connection.

A GOOD SOLDER CONNECTION



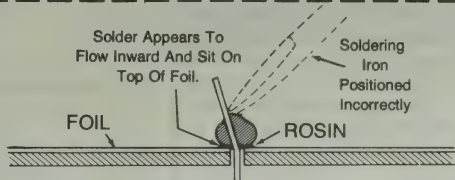
POOR SOLDER CONNECTIONS

Solder Does Not Flow Onto Lead. A Hard Rosin Bead Surrounds And Insulates Connection.



When the lead is not heated sufficiently, the solder will not flow onto the lead as shown above. To correct, reheat the connection and, if necessary, apply a small amount of additional solder to obtain a good connection.

Solder Appears To Flow Inward And Sit On Top Of Foil.

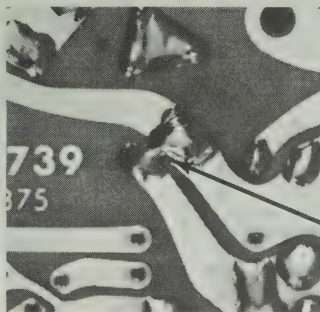


When the foil is not heated sufficiently the solder will blob on the circuit board as shown above. To correct, reheat the connection and, if necessary, apply a small amount of additional solder to obtain a good connection.

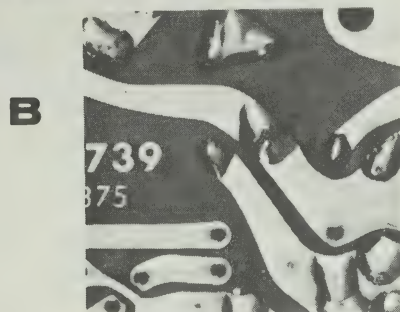
SOLDER BRIDGES

A solder bridge between two adjacent foils is shown in photograph A. Photograph B shows how the connection should appear. A solder bridge may occur if you accidentally touch an adjacent previously soldered connection, if you use too much solder, or if you "drag" the soldering iron across other foils as you remove it from the connection. A good rule to follow is: always take a good look at the foil area around each lead before you solder it. Then, when you solder the connection, make sure the solder remains in this area and does not bridge to another foil. This is especially important when the foils are small and close together. NOTE: It is alright for solder to bridge two connections on the same foil.

Use only enough solder to make a good connection, and lift the soldering iron straight up from the circuit board. If a solder bridge should develop, turn the circuit board foil-side-down and heat the solder between connections. The excess solder will run onto the tip of the soldering iron, and this will remove the solder bridge. NOTE: The foil side of most circuit boards has a coating on it called "solder resist." This is a protective insulation to help prevent solder bridges.



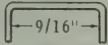
SOLDER BRIDGE



START ➔

NOTE: Make sure you have installed the resistor in Pictorial 1-1.

- () Form two 1" lengths of #14 solid wire:

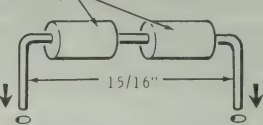


- () L5: One formed solid wire at L5. Push the wire flat down against the circuit board. Solder the wire ends to the foil.

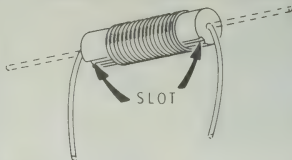
- () L6: One formed solid wire at L6. Solder the wire ends to the foil.

- () L7: Push two ferrite beads onto a 1-1/2" length of #14 solid wire and install at L7. Solder the wire ends to the foil.

FERRITE
BEADS



- () L9: .47 μ H RF choke (#45-74). Bend the leads toward the slot. Solder the wire ends to the foil.



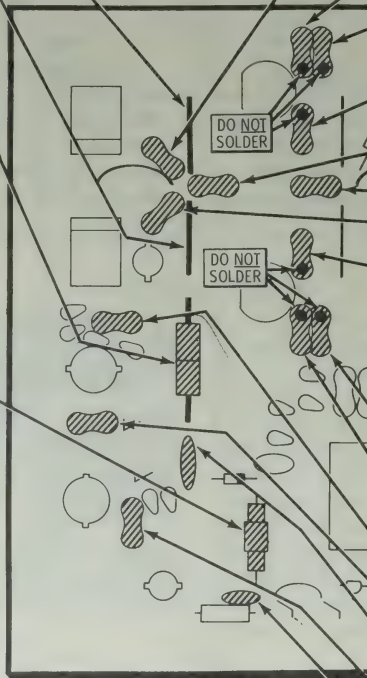
- () Make sure all leads are soldered to the foil. Cut off the excess lead lengths.

The steps performed in this Pictorial are in this area of the circuit board.

IDENTIFICATION
DRAWING



PART
NUMBER



PICTORIAL 1-2

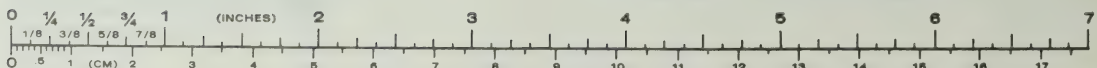
CONTINUE ➔

NOTE: When you install mica and ceramic capacitors, remove any excess coating from the leads. Use long-nose pliers to remove this coating. Be sure you push each capacitor down against the circuit board. You will solder the leads marked "DO NOT SOLDER" later. Cut these leads to a length of 1/2" below the foil.

REMOVE COATING
EVEN WITH BOTTOM
OF CAPACITOR BODY.

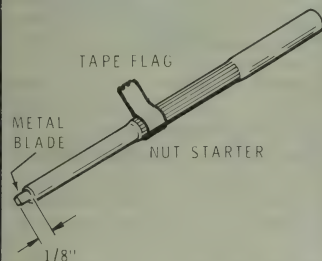


- () C13: 22 pF mica.
- () C5: 47 pF mica. Do not solder the marked lead yet.
- () C6: 47 pF mica. Do not solder the marked lead yet.
- () C4: 47 pF mica. Do not solder the marked lead yet.
- () C14: 22 pF mica.
- () C3: 68 pF mica.
- () C12: 22 pF mica.
- () C9: 47 pF mica. Do not solder the marked lead yet.
- () Solder the leads (except those marked) to the foil and cut off the excess lead lengths. SAVE TWO CUTOFF LEADS FOR USE LATER.
- () C8: 47 pF mica. Do not solder the marked lead yet.
- () C7: 47 pF mica. Do not solder the marked lead yet.
- () C22: 12 pF mica.
- () C23: 30 pF mica.
- () C11: .05 μ F ceramic.
- () C24: 12 pF mica.
- () C17: .001 μ F ceramic.
- () Solder the leads (except those marked) to the foil and cut off the excess lead lengths.



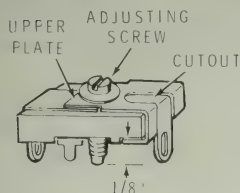
START

- (S) Make an alignment tool for the trimmer capacitors. Use a pair of pliers and push the 1" steel blade into the smaller end of the nut starter until 1/8" of the blade remains exposed.



- () Make a "flag" out of tape for the alignment tool so you can easily see the position of the tool.

- () Turn the adjusting screws of two trimmer capacitors clockwise until you feel resistance. The end of the screw should protrude about 1/8" from the ceramic capacitor body. Note the position of the cutout in the upper plate.



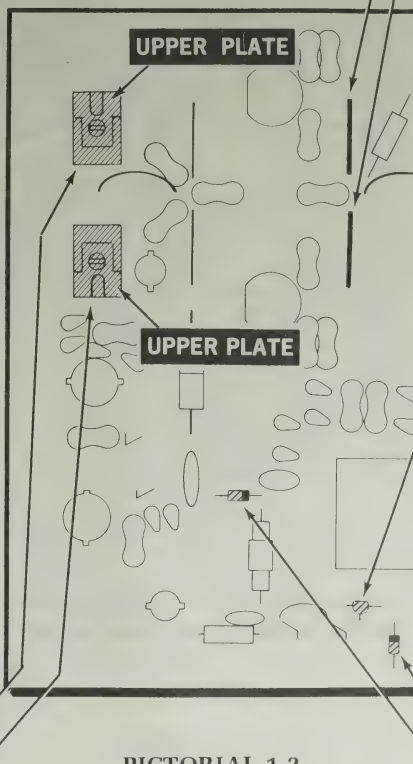
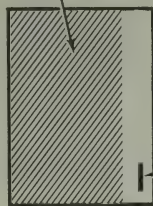
NOTE: In the following steps, make sure the capacitor body is parallel with the circuit board and that the end of the adjusting screw just touches the board. Solder the lugs of each capacitor as it is installed. Be sure to position the upper capacitor plate as shown.

- (✓) C15: Trimmer capacitor.

- (✓) C16: Trimmer capacitor.

The steps performed in this Pictorial are in this area of the circuit board.

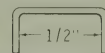
IDENTIFICATION
DRAWING



PICTORIAL 1-3

CONTINUE

- (✓) Form two 1" lengths of #14 solid wire.

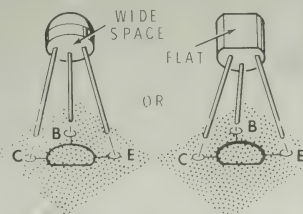


- (✓) L2: One formed solid wire. Solder the wire ends to the foil.

- (✓) L3: One formed solid wire. Solder the wire ends to the foil.

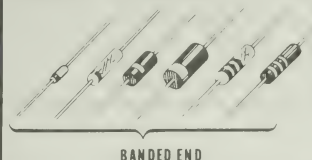
- () Cut off the excess wire lengths.

NOTE: To install the transistor in the following step, match the wide space or flat on the transistor body to the outline printed on the circuit board. Then insert the leads into the holes, push the transistor body down to within 1/4" of the circuit board, and solder each lead to the foil. Cut off the excess lead lengths. The transistor may be either one of the two types shown below.



- (✓) Q3: 2N3641 transistor (#417-155).

NOTE: Diodes may be supplied in any of the following shapes. The cathode end of the diode is marked with one or more bands. Always position this end as shown in the Pictorial.



- (✓) D2: 1N4149 diode (#56-56).

- (✓) D1: 1N4149 diode (#56-56).

- (✓) Solder the leads to the foil and cut off the excess lead lengths.

The steps performed in this Pictorial are in this area of the circuit board.

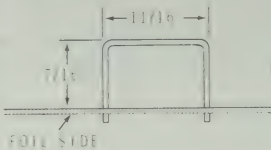
START

- () Cut two 2" lengths of #14 solid wire. You will use these wires to form inductors L1 and L8 in the following steps.

NOTE: In each of the following two steps, you must form the #14 solid wire so it exactly covers the drawing in the Detail below. The wire length is critical at the frequencies covered by this Amplifier. Be careful when you form and install the inductors. A pair of long-nose pliers may prove useful when you form each inductor.

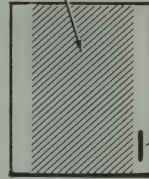
Although illustrated differently to show their location, you must install the two inductors perpendicular (at right angles) to the circuit board.

- ✓ L8: Form an inductor from one of the two #14 solid wires and mount it at L8 to the dimensions shown. Solder the leads to the foil and cut off the excess lead lengths.



- ✓ L1: In the same manner, form an inductor from the other #14 solid wire and mount it at L1 to the dimensions shown above. Solder the leads to the foil and cut off the excess lead lengths.

IDENTIFICATION
DRAWING



PART
NUMBER

CONTINUE

NOTE: The resistor you will install in the following step will be 1000 Ω if the two power transistors you received are B25-12. If you received 2N5591 power transistors, however, use a 2700 Ω resistor.

- () R4: 1000 Ω (brown-black-red) OR 2700 Ω (red-violet-red).

NOTE: Again read the installation instructions for trimmer capacitors in Pictorial 1-3 before you perform the following two steps.

- ✓ C2: Trimmer capacitor.

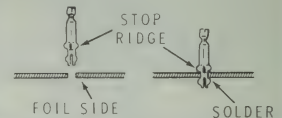
- ✓ C1: Trimmer capacitor.

- ✓ C19: 5 pF mica.

- ✓ C21: 5 pF mica.

- () Solder all the leads to the foil and cut off the excess lead lengths.

NOTE: Install connector pins in the following steps. Solder each pin to the foil as you install it.



- () Connector pin at TP3.

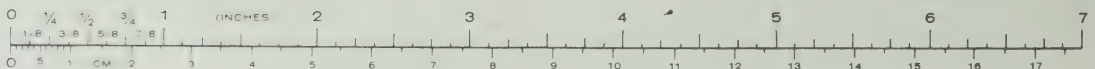
- () Connector pin at TP4.

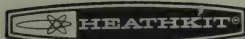
- () Two connector pins. NOTE: Do not install a 2.7 pF ceramic capacitor yet.

- () Connector pin at TP2.

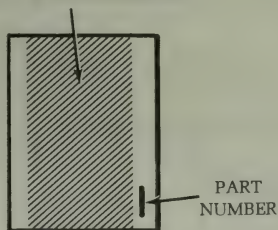
- () Connector pin at TP1.

PICTORIAL 1-4



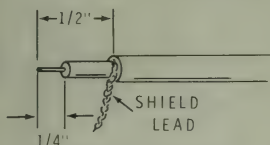


The steps performed in this Pictorial are in this area of the circuit board.



START

- () Cut off four lengths of RG-174 coaxial cable (three 4" lengths, and one 3" length). Prepare both ends of each cable as follows.

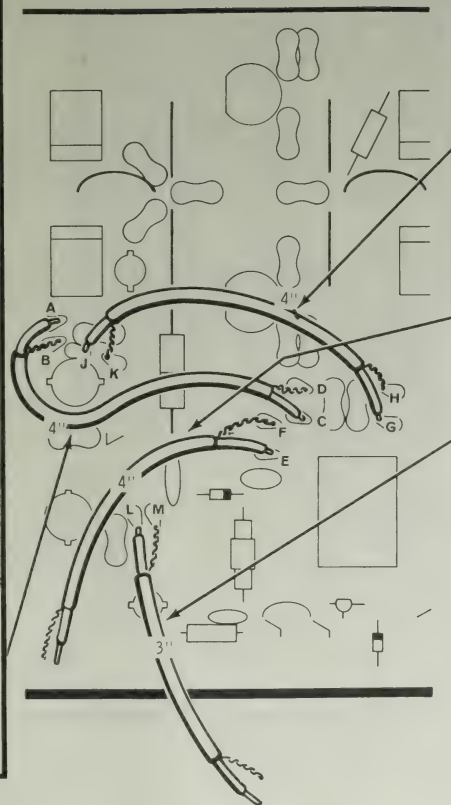


1. Remove 1/2" of the outer insulation.
2. Use a pointed object and comb out the braided shield wires.
3. Twist the shield wires tightly together to form a lead.
4. Remove 1/4" of insulation from the inner lead.
5. Melt a small amount of solder to the end of the shield lead and on the inner lead.

NOTE: As you install the shielded cables in the following steps, solder the leads to the foil and cut off the excess lead lengths.

- () At one end of one 4" cable, connect the shield lead to hole B and the inner lead to hole A. Form the cable across the board as shown. Then connect the shield lead, at the free end of this cable, to hole D and the inner lead to hole C.

IDENTIFICATION
DRAWING



CONTINUE

- () At one end of the second 4" cable, connect the shield lead to hole K and the inner lead to hole J. Form the cable across the board as shown. Then connect the shield lead, at the free end of the cable, to hole H and the inner lead to hole G.
- () At one end of the remaining 4" cable, connect the shield lead to hole F and the inner lead to hole E. The free end of this cable will be connected later.
- () At one end of the 3" cable, connect the shield lead to hole M and the inner lead to hole L. The free end of this cable will be connected later.

PICTORIAL 1-5

The steps performed in this Pictorial are in this area of the circuit board.

IDENTIFICATION
DRAWING



PART
NUMBER

START

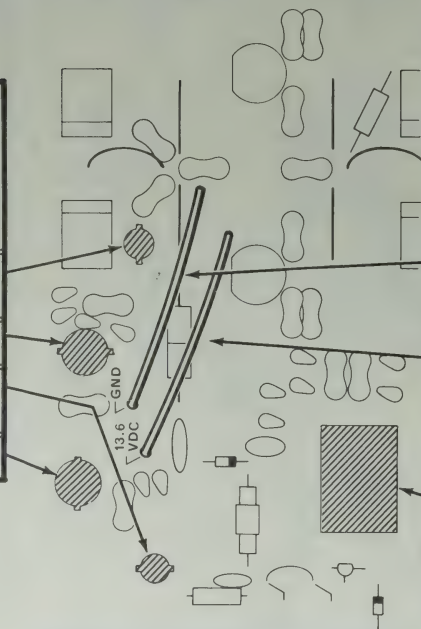
NOTE: When you install each of the following coils, make sure you hold the coil down **firmly** against the circuit board while you solder the leads to the foil. Then cut off the excess lead lengths. Each coil may be installed either way.

✓ L11: 22 nH coil (brown, #40-1928).

✓ L12: 56 nH coil (red, #40-1927).

✓ L14: 22 nH coil (brown, #40-1928).

✓ L13: 56 nH coil red, #40-1927).



CONTINUE

() Cut two 2" lengths of #14 solid wire.

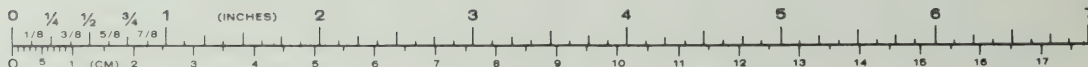
() NOTE: In the following two steps, do not allow the wires to protrude more than 1/8" below the foil when you solder them.

✓ Install a 2" #14 solid wire at hole GND and solder the wire to the foil.

✓ Install a 2" #14 solid wire at hole +13.6 VDC and solder the wire to the foil.

✓ RL1: Relay (#69-91). First, make sure the relay pins are perpendicular to the relay case bottom. Then line up the relay pins with the proper circuit board holes and install the relay. Make sure the relay case bottom is parallel with the circuit board; then solder the pins to the foil.

PICTORIAL 1-6



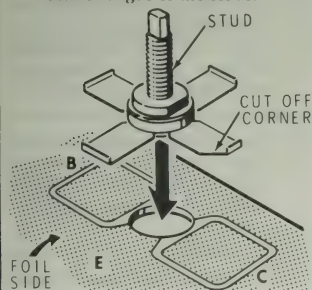
START ➡

IMPORTANT: If the two power transistors furnished (part #417-299) are type 2N5591, install them as shown in this Pictorial. If the transistors furnished are type B25-12, follow the steps on Page 16 and disregard this page.

- () Turn the circuit board foil-side-up so the board part number is in the position shown.

- () **CAUTION:** Handle power transistors, particularly the studs, with care.

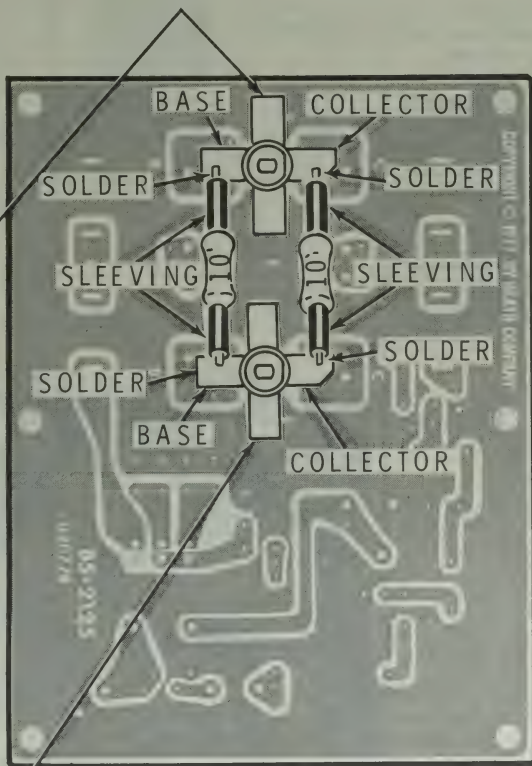
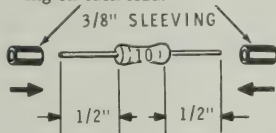
- () Q1: Using a pair of long-nose pliers, bend up the end (1/16" long) of each of the four transistor leads as shown below. From the foil side of the circuit board, place the round, white, top portion of a 2N5591 transistor into the hole shown. Position the lead with the cut-off corner so it points to the letter C in the foil. Form the leads down against the foil for as much of their length as possible. Solder each lead to the foil. Carry the solder up as close as possible to the transistor body to reduce the effective length of the leads.



- () Q2: 2N5591 transistor, installed as in the preceding step.

- () Solder the six capacitor leads which were not soldered earlier. Cut off the excess lead lengths.

- () Cut the leads of two 10 Ω (brown-black-black) resistors to 1/2". Place a 3/8" length of sleeving on each lead.

**CONTINUE** ➡

- (✓) Connect a 10 Ω resistor from the base of one transistor to the base of the other transistor. Solder the leads directly to the base leads.
- (✓) Connect a 10 Ω resistor from the collector of one transistor to the collector of the other transistor. Solder the leads directly to the collector leads.
- (✓) Inspect the circuit boards carefully to make sure the sleeving completely covers the resistor leads except over the leads where they are connected.

NOTE: One or two connector pins may remain unused.

PICTORIAL 1-7

START

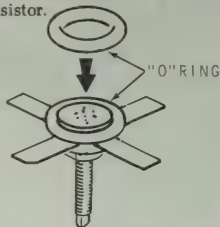
IMPORTANT: Follow this Pictorial ONLY if you were furnished two type B25-12 power transistors (part #417-299).

CAUTION: Handle power transistors, particularly the studs, with care.

- () Stretch a white "O" ring by rolling it onto a round object such as a pencil. Repeat this action two or three times to stretch the "O" ring the maximum amount. Then remove the ring.

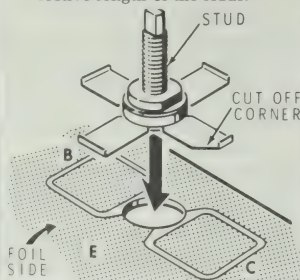


- () Carefully stretch the "O" ring onto the round, white top of the transistor.



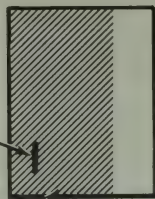
- () Turn the circuit board foil-side-up so the board part number is in the position shown.

- () Q1: Using a pair of long-nose pliers, bend up the end (1/16" long) of each of the four transistor leads as shown below. From the foil side of the circuit board, place the round, white, top portion of a B25-12 transistor into the hole shown. Position the lead with the cut-off corner so it points to the letter C in the foil. Form the leads down against the foil for as much of their length as possible. Solder each lead to the foil. Carry the solder up as close as possible to the transistor body to reduce the effective length of the leads.



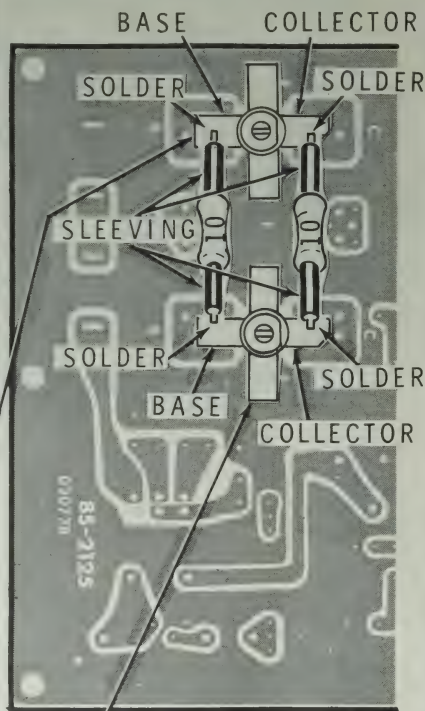
- () Q2: B25-12 transistor installed as in the preceding instructions.

PART
NUMBER



The steps performed in this Pictorial are in this area of the circuit board.

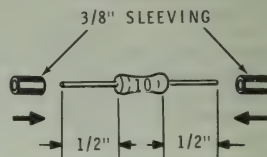
IDENTIFICATION
DRAWING

**CONTINUE**

- () After each transistor is soldered in place, remove and discard the "O" ring from each transistor. Use a darning needle, or similar pointed object.

- () Solder the six capacitor leads which were not soldered earlier. Cut off the excess lead lengths.

- () Cut the leads of two 10 Ω (brown-black-black) resistors to 1/2". Place a 3/8" length of sleeving on each lead.



- () Connect a 10 Ω resistor from the base of one transistor to the base of the other transistor. Solder the leads directly to the base leads.

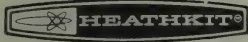
- () Connect a 10 Ω resistor from the collector of one transistor to the collector of the other transistor. Solder the leads directly to the collector leads.

- () Inspect the circuit boards carefully to make sure the sleeving completely covers the resistor leads except over the leads where they are connected.

NOTE: One or two connector pins may remain unused.

FINISH

PICTORIAL 1-8



CIRCUIT BOARD CHECKOUT

Carefully inspect the circuit board for the following conditions.

- () Unsoldered connections.
- () Poor solder connections.
- () Solder bridges between foil patterns.
- () Protruding leads. No lead should be more than $1/8"$.
- () Transistor for proper installation.
- () Diodes for the correct position of the banded end.

CHASSIS ASSEMBLY AND WIRING

NOTES:

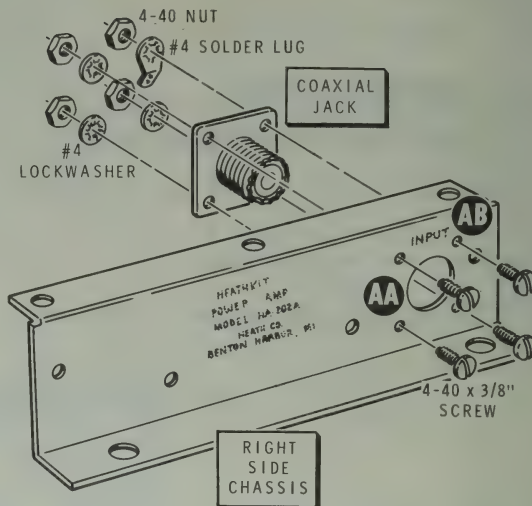
1. When a step calls for hardware, only the screw size will be given. For example, if $6-32 \times 1/4"$ hardware is called for, it means you should use a $6-32 \times 1/4"$ screw, one or more #6 lockwashers, and a 6-32 nut at each mounting hole. The Detail referred to in the step will show you the proper number of lockwashers to use.
2. A plastic nut starter has been provided with this kit. Use it to hold and start 6-32 and 4-40 nuts on screws.

Refer to Pictorial 2-1 for the following step.

- (✓) Locate the right side (INPUT) chassis. Then mount a coaxial jack at AA with a #4 solder lug at AB. Use $4-40 \times 3/8"$ hardware. Position the solder lug as shown in the Pictorial.

Refer to Pictorial 2-2 for the following steps.

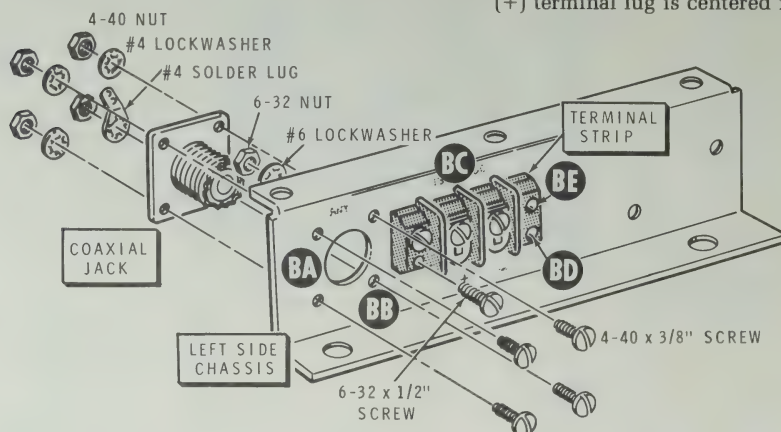
- (✓) Locate the left side (ANT.) chassis. Then mount a coaxial jack at BA with a #4 solder lug at BB. Use $4-40 \times 3/8"$ hardware. Position the solder lug as shown in the Pictorial.



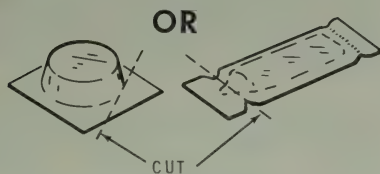
PICTORIAL 2-1

- (✓) Mount the terminal strip at BC on the left side (ANT.) chassis. Do NOT install screws in holes BD and BE at this time. Use $6-32 \times 1/2"$ hardware at the remaining two holes.

- () Tighten the two terminal strip screws (in addition to the two mounting screws). Make sure the (+) terminal lug is centered in its hole.



PICTORIAL 2-2



Detail 2-3A

Refer to Pictorial 2-3 (Illustration Booklet, Page 2) for the following steps.

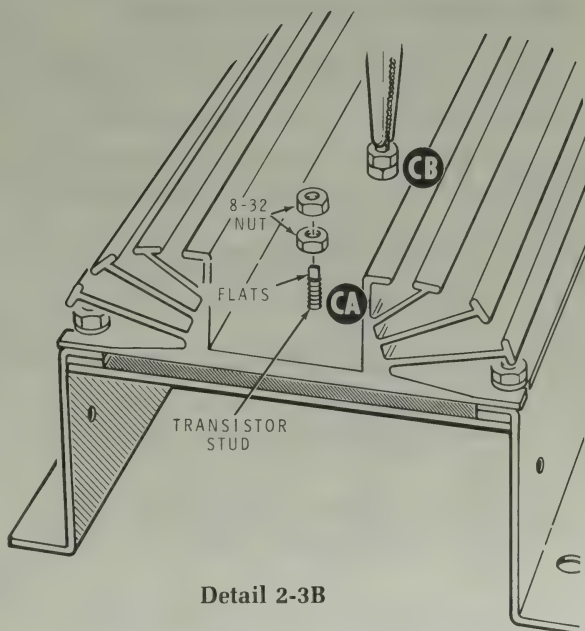
NOTE: In the following steps, (NS) means not to solder because other wires will be added later.

- () Cut a 1/4" length of sleeving and slide it as far as possible onto terminal strip BC lug 1 (+) so this lug cannot short to the chassis.
- () C25: Refer to the inset drawing and connect the + lead of a 22 μ F tantalum capacitor to terminal strip BC lug 1 (NS). Connect the other lead to terminal strip BC lug 2 (NS).

WARNING: The silicone grease you will use in the following step helps transfer heat from the transistor to the heat sink. The grease is not caustic, but make sure you do not get it into your eyes, ears, nose, mouth, or clothing. Always wash your hands after you use the grease. Keep this and all chemicals out of the reach of children.

- () Refer to Detail 2-3A and open the silicone grease container by cutting into the container just enough to make a small opening. Use diagonal cutters or scissors.
- () Smear silicone grease around holes CA and CB on the flat side of the heat sink as shown in the Pictorial.

NOTE: In the following step, it may be easier to install the hardware if you position the assembly on one end and first install the top screw in each row. Insert the screw, place the lockwasher on the screw; then hold the nut on the end of the screw with long-nose pliers as you turn the screw with a screwdriver. Take care not to put any strain on the transistor studs during the following assembly.



Detail 2-3B

- () Assemble the circuit board, the right side (INPUT) chassis, the left side chassis, the spacer strips, and the heat sink. Position the heat sink so the transistor studs fit through holes CA and CB of the heat sink. Use 10-32 \times 1/2" hardware.

NOTE: To prevent damage to the power transistors, it is important that you follow the instructions for tightening the nuts exactly as they are given in the next steps.

- () Refer to Detail 2-3B and start **one** 8-32 nut onto each transistor stud at CA and CB.
- () Use your fingers **ONLY** and tighten the nut on each stud as much as possible.
- () Hold the flats on the end of the transistor stud with pliers to keep the transistor stud from turning. Then tighten each transistor mounting nut 1/8 turn more with the open end wrench furnished.
- () Start a second 8-32 nut onto each transistor stud. Hold the flats with pliers, as before, and tighten the second nuts down against the first ones to serve as locknuts.

Refer to Pictorial 2-4 for the following steps.

NOTE: "S-" with a number, such as (S-2), means to solder the connection. The number following the "S" tells you how many wires are at the connection.

CAUTION: To prevent damage to the circuit board as you form the bare wires in the following steps, hold each wire with thin nose pliers at the surface of the board whenever you bend the wire. The pliers will then take the bending force instead of the circuit board.

- (✓) Form the wire coming from GND on the circuit board so it touches terminal strip BC lug 2 (S-2). Cut off any excess wire.
- (✓) Slide a 1-1/2" length of sleeving onto the bare wire coming from "+13.6 VDC" on the circuit board.
- (✓) Form this bare wire so it touches terminal strip BC lug 1 (S-2). Cut off any excess wire.
- (✓) Install a 6-32 \times 1/2" screw, a #6 solder lug, and a 6-32 nut at hole BD in terminal strip BC. Position the solder lug so it touches lug 2 as shown in the Pictorial. Solder it to lug 2.
- (✓) Install a 6-32 \times 1/2" screw, a #6 lockwasher, and a 6-32 nut at hole BE in terminal strip BC.
- (✓) At the free end of the coaxial cable coming from holes L and M on the circuit board, connect the inner lead to the center conductor of coaxial jack BA (S-1) and the shield lead to solder lug BB (S-1).

(✓) At the free end of the coaxial cable coming from holes E and F on the circuit board, connect the inner lead to the center conductor of coaxial jack AA (S-1) and the shield lead to solder lug AB (S-1).

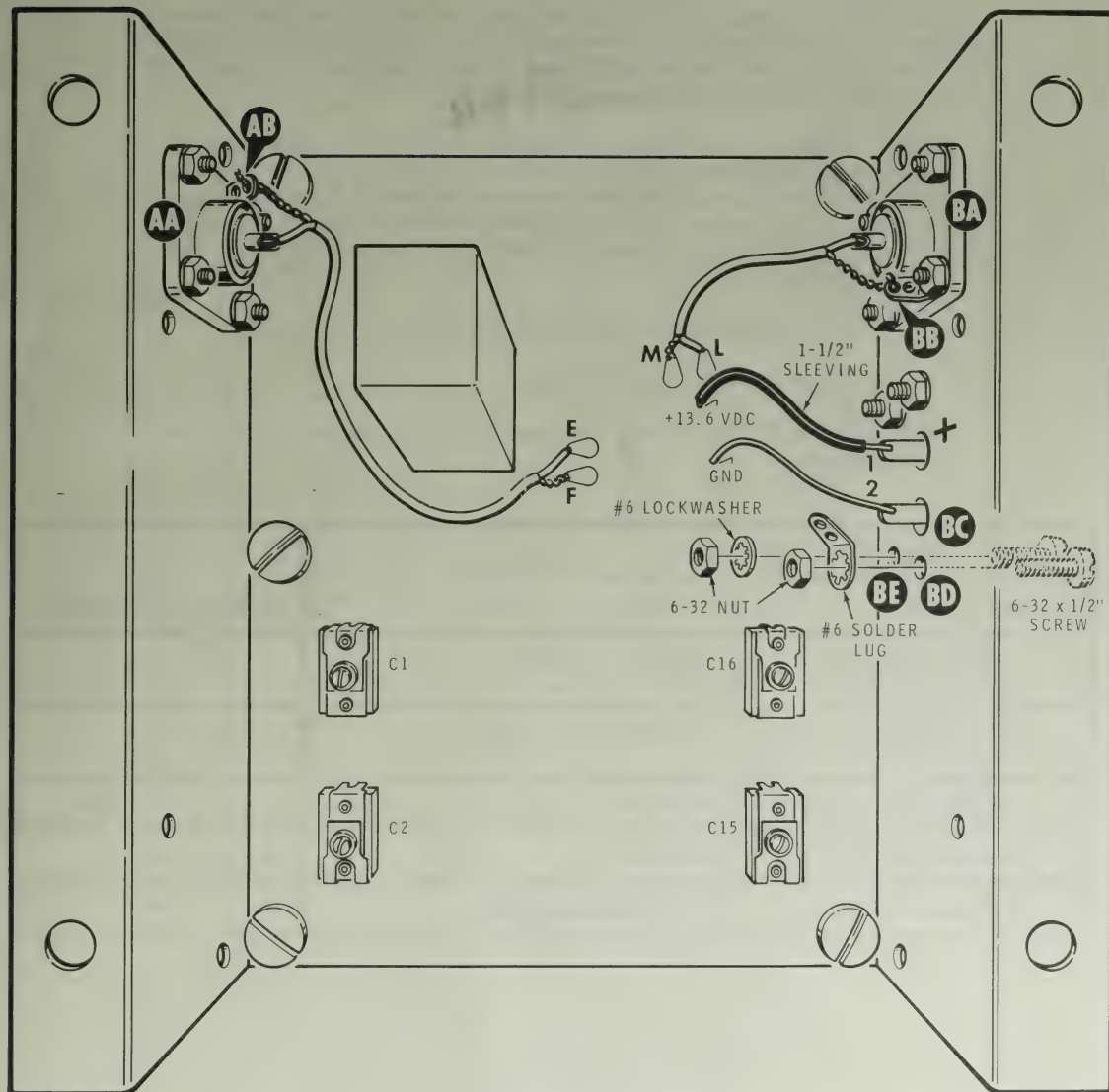
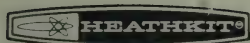
() Make sure the adjusting screws of the four trimmer capacitors are still fully clockwise. Refer to Pictorial 2-5 and turn each trimmer counterclockwise as follows:

Trimmer	B25-12 at Q1, Q2	2N5591 at Q1, Q2
C1	1/4 turn	1/2 turn
C2	1/2 turn	1/2 turn
C15	1/4 turn	1/4 turn
C16	1/4 turn	1/2 turn

NOTE: Two 2.7 pF ceramic capacitors are left over. Also a 1000 Ω or 2700 Ω resistor will be left over depending on which resistor you installed at R4.

This completes the assembly of your 2-Meter FM Amplifier. Before you proceed, look it over carefully to be sure:

1. That all hardware is tightened.
2. There are no unsoldered connections.
3. There are no cutoff wire ends or solder splashes lodged in the wiring.
4. There are no protruding wire ends that could short to another lug or the chassis.



PICTORIAL 2-4

INITIAL TESTS

You will now use an ohmmeter to make resistance checks on the circuit board. This test will tell if a short or open circuit exists, which might cause problems when you apply power to the circuit board. **DO NOT** apply power to the circuit board until the difficulty has been corrected.

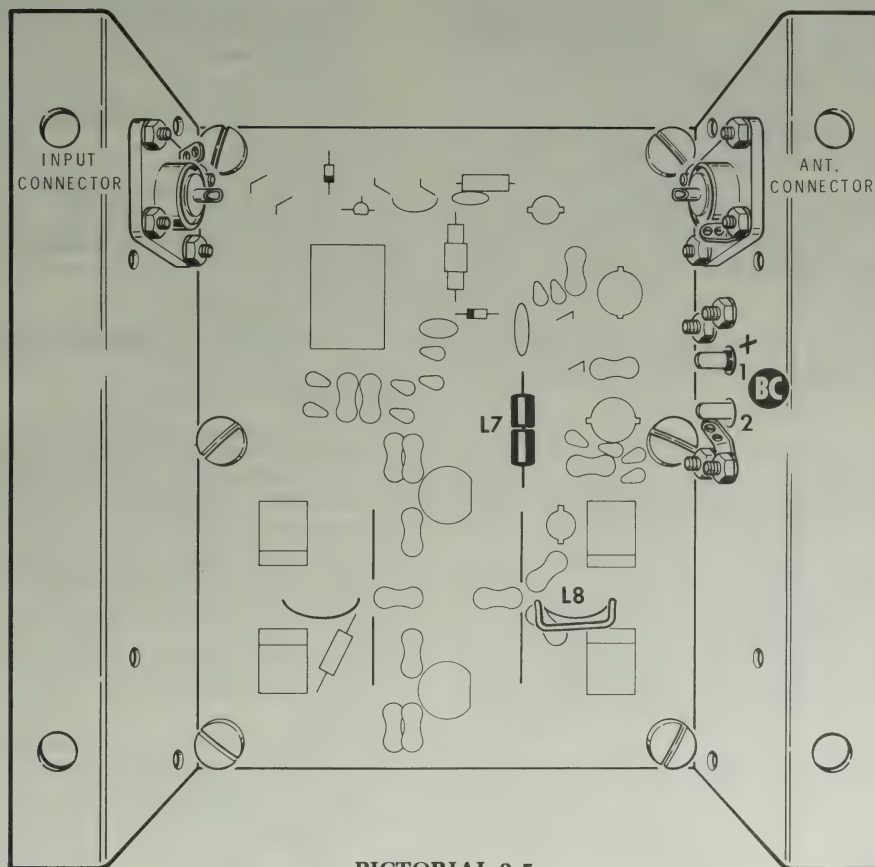
NOTE: The internal wiring of most ohmmeters is such that the positive terminal of the meter battery is connected to the positive test lead and the negative battery terminal is connected to the negative (common) test lead. In some ohmmeters, this wiring is reversed and will give erroneous readings in the following measurements. Interchange the ohmmeter leads if the measurements do not check out correctly the first time.

() Turn on your ohmmeter and allow it to warm up, if necessary.

() Set the ohmmeter to the $R \times 1$ range.

Refer to Pictorial 2-5 to identify the Amplifier test points called out in the following steps.

OHMMETER TEST POINTS		RESISTANCE IN OHMS
COMMON LEAD	POSITIVE (+) LEAD	
() Center conductor of ANT. connector.	Center conductor of INPUT connector.	0
() Center conductor of ANT. connector.	Terminal strip BC lug 2.	∞
() Terminal strip BC lug 1.	Inductor L7.	0
() Terminal strip BC lug 1.	Inductor L8.	0
() Terminal strip BC lug 2.	Terminal strip BC lug 1.	∞



PICTORIAL 2-5

INSTALLATION

You may use this Amplifier in any vehicle which has a 13.6 VDC negative ground electrical system or with a 7-ampere DC supply such as the Heathkit HP/PS 1175. Refer to the "Operation" section of this Manual for a discussion on DC power systems.

Refer to Pictorial 3-1 for the suggested arrangement of components and their interconnections.

You will complete all installation steps before you align your 2-Meter FM Amplifier, except for installing the amplifier cover and securing the completed Amplifier in place.

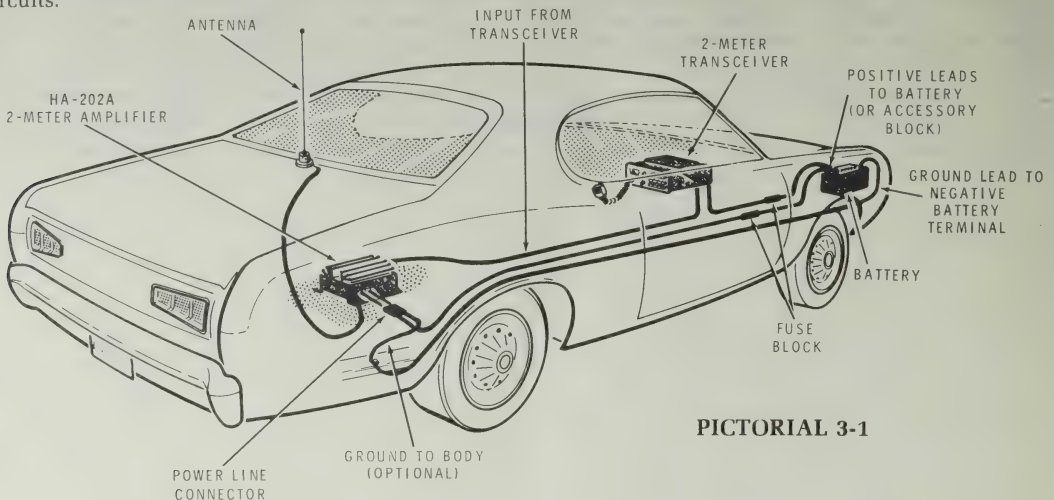
Without excitation, this Amplifier draws less than 1 mA of current; therefore, on-off switching is not required.

Although the standard installation instructions suggest that you connect the amplifier power wire to a fuse near the battery, it is possible that an unused circuit is available on the accessory fuse block of your automobile. Normally, such a circuit has provision for a fuse, and in that case, you can connect the red power wire to this terminal. (NOTE: A 1/4" push-on connector is supplied with this kit. If any other connector is required, you should purchase it locally.) The automobile ignition switch will usually control this circuit in the same manner as the other accessory circuits.

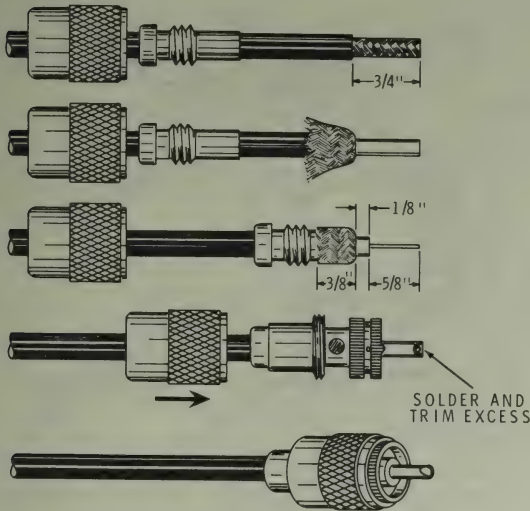
- () Decide where the Amplifier will be installed. It should be located as close to the antenna as is convenient. NOTE: Do **not** install the Amplifier in the engine compartment of your automobile. During normal operation, temperatures as high as 260°F can be expected there.
- () Mark the mounting holes for the Amplifier. Use the Amplifier assembly as a template.
- () Drill the mounting holes with a #21 or a 5/32" drill bit. You will use #10 sheet metal screws to mount the Amplifier later.

TRANSMISSION LINES

- () Carefully measure the lengths of transmission line required between the exciter and the Amplifier, and between the Amplifier and the antenna.
- () Cut an RG-58A/U coaxial cable (not furnished) to the measured lengths.
- () Refer to Pictorial 3-2 and install a coaxial plug and a coaxial plug insert on one end of each cable.



PICTORIAL 3-1

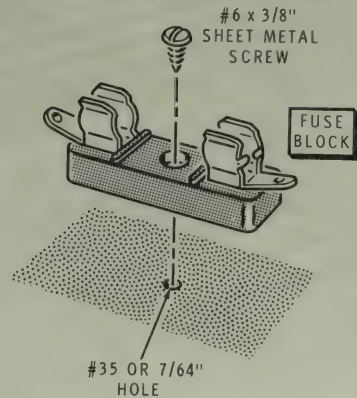


PICTORIAL 3-2

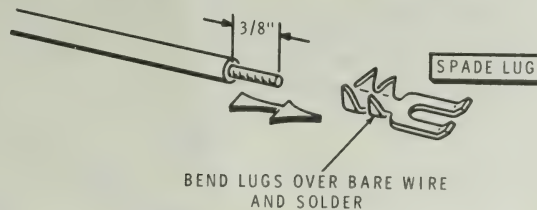
POWER LINES

NOTE: Complete the following five steps only if you intend to install your Amplifier in your automobile.

- () 1. Refer to Pictorial 3-3 and install the fuse block close to the battery. Use a #6 \times 3/8" sheet metal screw in a hole drilled with a #35 or a 7/64" bit.
- () 2. Cut a stranded red wire to reach from the fuse block to the positive battery terminal. Solder one end of this wire to the fuse block. Do NOT connect the free end of this wire until you are instructed to do so.
- () 3. Install one of the fuses supplied in the clips on the fuse block.
- () 4. Cut a 12" stranded black wire and a 12" stranded red wire. Remove 1/4" of insulation from one end and 3/8" from the other end of each wire.
- () 5. Refer to Pictorial 3-4 and install a spade lug on the 3/8" end of each wire.

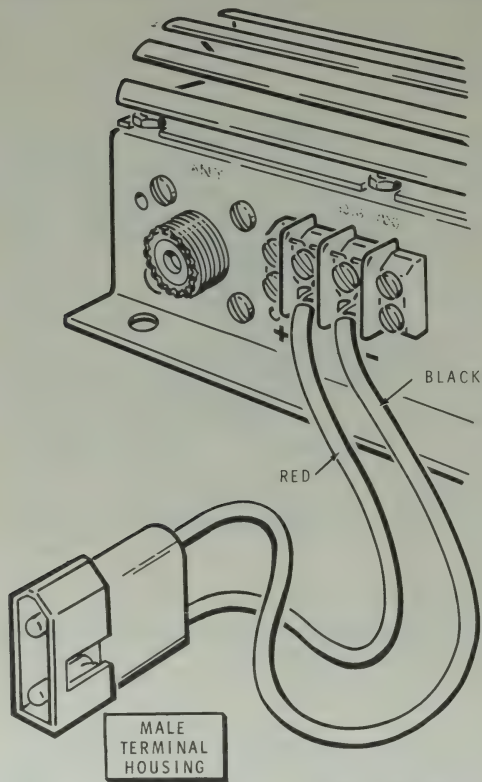


PICTORIAL 3-3



PICTORIAL 3-4

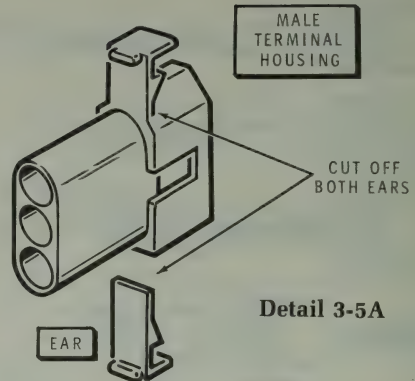




PICTORIAL 3-5

Refer to Pictorial 3-5 for the following steps.

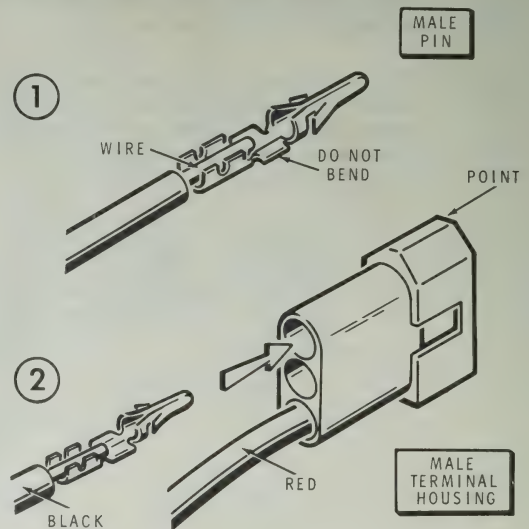
- () 1. Refer to Detail 3-5A and cut off and discard the two "ears" from a male terminal housing.
- () 2. Refer to Part 1 of Detail 3-5B and solder a male pin to the remaining end of each wire.
- () 3. Position the male terminal housing with the pointed end up, as shown in Part 2 of Detail 3-5B. Then push the male pin on the black wire into the upper hole, as shown, until the pin locks into place.
- () 4. Similarly, push the pin on the red wire into the lower hole, leaving the center hole open.
- () 5. Connect the spade lug on the red wire to terminal strip BC lug 1 (+). Connect the spade lug on the black wire to terminal strip BC lug 2 (-). Make sure you tighten both screws securely.



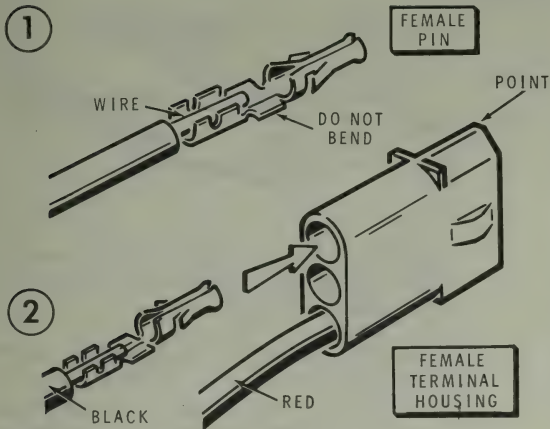
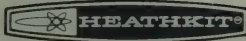
Detail 3-5A

NOTE: Complete the following nine steps only if you intend to install your Amplifier in your automobile.

- () 1. With the Amplifier temporarily in its permanent location, cut the stranded red wire required to reach from the male terminal housing to the fuse block (or the accessory fuse block, if used).
- () 2. Cut the stranded black wire required to reach from the male terminal housing to the ground point selected on the auto body.



Detail 3-5B

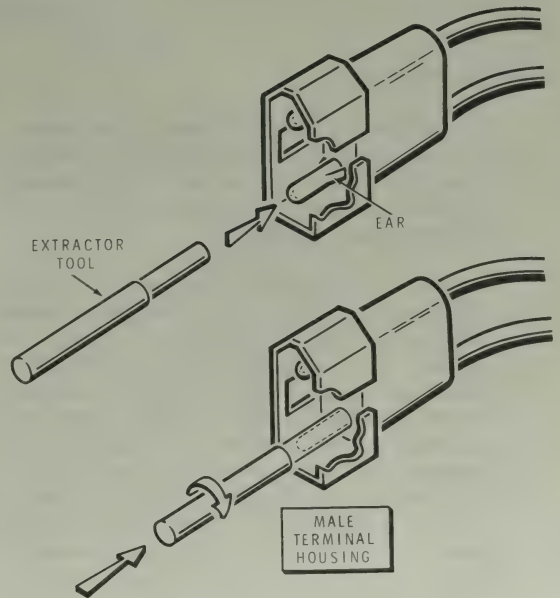


PICTORIAL 3-6

- () 3. Cut the stranded black wire required to reach from the negative battery terminal to the ground point selected in the previous step.
- () 4. Remove 1/4" of insulation from both ends of both black wires and the red wire.

Refer to Pictorial 3-6 for the following steps.

- () 5. Refer to Part 1 of the Pictorial and solder a female pin to one end of the short black wire and the red wire.
- () 6. Position the female terminal housing with the pointed end up as shown in Part 2 of the Pictorial. Then push the female pin on the black wire into the upper hole, as shown, until the pin locks into place.
- () 7. Similarly, push the pin on the red wire into the lower hole leaving the center hole open.



PICTORIAL 3-7

NOTE: An extractor tool is furnished (see Pictorial 3-7) so you can remove a pin from one of the terminal housings, if necessary. To use the tool, push it very firmly over the end of the pin, as shown, until it compresses the expanded ears of the pin. When this occurs, the wire with its pin can be pulled from the other end of the housing.

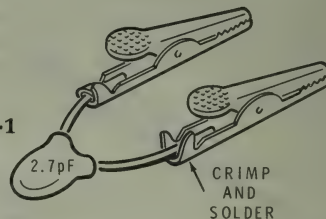
- () 8. Route the free end of the red wire toward the battery and solder it to the remaining lug of the fuse block.
- () 9. Make sure the male and female terminal housings are not plugged together. Then connect the free end of the red wire coming from the fuse block to the battery.

ALIGNMENT

Alignment Notes

1. To avoid overheating and damaging the transistors, do not key the exciter continuously during alignment. A cycle of five seconds on followed by ten seconds off is recommended until alignment has been completed.
2. Although it is unlikely, you could encounter low-frequency oscillation (squegging) under certain conditions of mistuning. When it is properly tuned, the Amplifier will not exhibit these oscillations, but low-frequency spurious output has been observed during alignment, and this condition can destroy Q1 and Q2 if it is allowed to exist for any length of time. A portable broadcast receiver makes a good indicator when it is tuned to an unused frequency and placed near the Amplifier. Squegging is easy to recognize as an unusual noise from the broadcast receiver.
3. If you use your battery as a power source, check the voltage across its terminals with the engine running and all accessory equipment and lights off. This Amplifier is designed for 16 volts maximum input, and if the voltage exceeds this figure you should have your voltage regulator adjusted or replaced.
4. It is good practice to start the tuneup procedure at 11 to 12 volts input. If you are using your battery as a power source, leave the engine off during the initial alignment steps. Then start the engine (in a well-ventilated area) for the final tuneup.
5. The relay may chatter until C2 is peaked. This is normal and is due to the low input impedance possible when the Amplifier is mistuned.
6. The alignment of this Amplifier requires the following:
 - a. A two-meter exciter (transmitter) capable of ten to fifteen watts output.
 - b. A 50 Ω nonreactive load, such as the Heathkit Cantenna, connected to the Amplifier's output. An antenna may be used, but its VSWR should be as low as possible, and in

PICTORIAL 4-1



no event, more than 2:1. If the antenna VSWR is greater than 2:1, tune the antenna per the manufacturer's instruction.

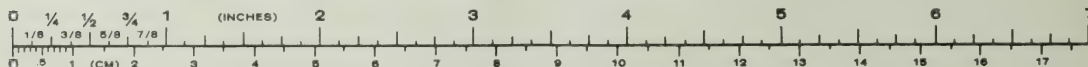
- c. An output indicator. A watt meter (or SWR bridge) is preferred, but a voltmeter may be used. The instructions and the connections for these two devices differ; therefore, separate alignment instructions are given below. Follow the appropriate set of instructions for the alignment equipment you have.
7. Before starting alignment, tune your exciter for maximum output in the portion of the 2-meter band in which you expect to operate. The Amplifier operating range will then be approximately 750 kHz each side of the alignment frequency.
 8. When you are driving the Amplifier using an exciter with automatic VSWR shut down (that is; controlled power output), the Amplifier must be aligned using a minimum of 10 watts of drive. This is required because of the sensitivity of the automatic shutdown circuitry in the exciter. This circuitry could cause an oscillation during the alignment when less than 10 watts of drive is used. After you have aligned the Amplifier, you may reduce driving power to 5 watts.

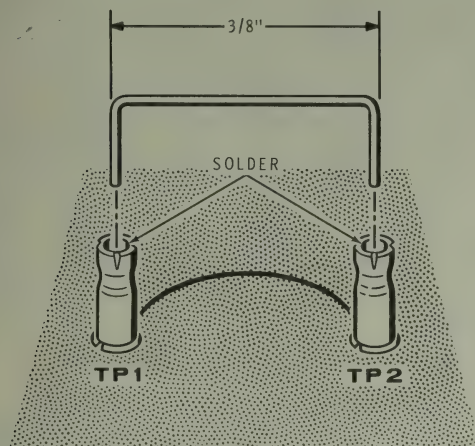
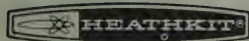
ALIGNMENT PREPARATION

NOTE: Complete the following two steps only if you plan to align your 2-meter FM Amplifier using a voltmeter.

- () Cut each lead of a 2.7 pF ceramic capacitor to 1/2".
- () Refer to Pictorial 4-1 and install an alligator clip on each lead of the prepared 2.7 pF ceramic capacitor.

Lay aside the capacitor/alligator clip assembly. It will be used later.





PICTORIAL 4-2



PICTORIAL 4-3

ALIGNMENT WITH A WATTMETER OR AN SWR BRIDGE

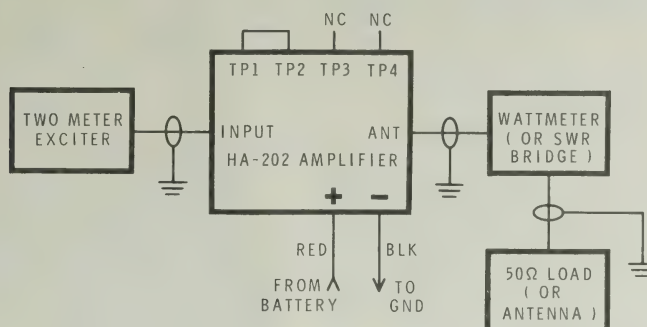
If a wattmeter or SWR bridge is used for alignment, it is important that they are capable of accurate measurements at the operating frequency of the Amplifier. Otherwise, there may be a false indication of peak power output and possible misalignment.

- () Refer to Pictorial 4-2 and cut a capacitor lead (laid aside earlier) to 5/8". Bend the ends down to form a U-shaped connector. Place the ends in connector pins TP1 (S-1) and TP2 (S-1).

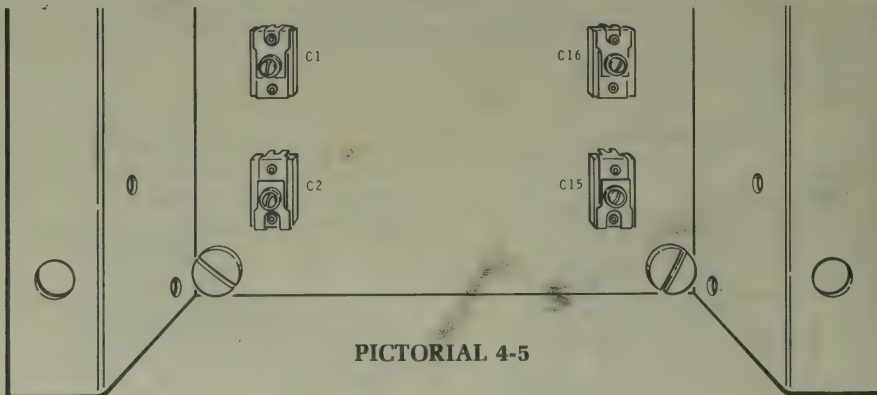
- () Cut the leads of the remaining 2.7 pF ceramic capacitor to 1/4". Then place the capacitor lead ends in the connector pins inside the outline for the 2.7 pF capacitor on the circuit board. See Pictorial 4-3. Solder both leads to the connector pins.

- () Interconnect your equipment as shown in Pictorial 4-4. Make sure you use RG-58A/U, RG-8A/U, or similar 50 Ω coaxial cable for all leads that carry RF.

- () Plug the power line connectors together.



PICTORIAL 4-4



PICTORIAL 4-5

NOTE: When you adjust trimmer capacitor C1 in the following steps, it will tune broadly.

- () 1. While you key the exciter 5 seconds on and 10 seconds off, use the alignment tool constructed earlier to adjust capacitors C2, C15, and C16 (see Pictorial 4-5) in the sequence listed for maximum meter indication.
- () 2. Readjust capacitors C1, C2, C15, and C16 in the sequence listed for maximum meter indication.
- () 3. Adjust capacitor C1 slowly clockwise, then counterclockwise, while you observe the meter to determine when output power starts to decrease. Then set capacitor C1 to the middle of this range.
- () Disconnect the wattmeter, the 50 Ω load, and the power line connectors.

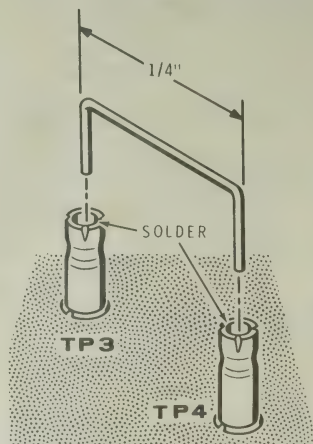
This completes the alignment. Proceed to "Final Assembly."

ALIGNMENT WITH A VOLTMETER

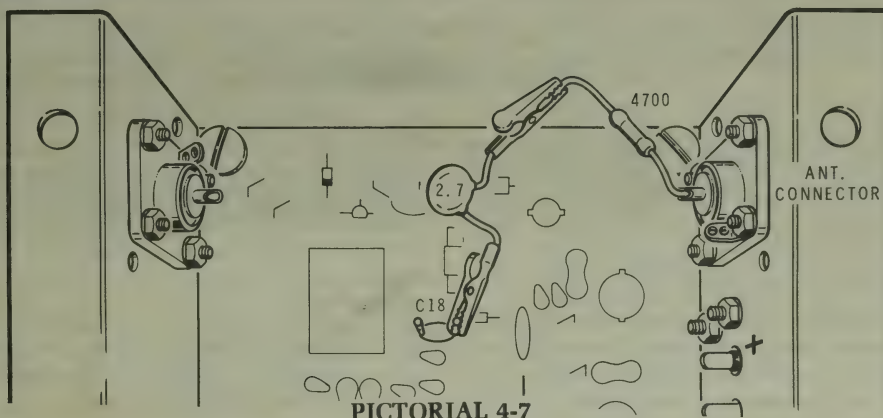
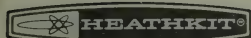
- () Refer to Pictorial 4-6 and cut a capacitor lead (laid aside earlier) to 1/2". Bend the ends down to form a U-shaped connector. Place the ends of this connector in TP3 and TP4. Use a minimum amount of solder (this connector will be removed later) and solder the connector to TP3 and TP4.

Refer to Pictorial 4-7 for the following steps.

- () Clip one lead of the 2.7 pF ceramic capacitor to the indicated connector pin on the circuit board.
- () Temporarily solder one lead of a 4700 Ω (yellow-violet-red) resistor to the center conductor of the ANT. connector. NOTE: A coaxial cable was previously soldered to this terminal. Clip the other lead of C18, the 2.7 pF ceramic capacitor, to the free end of the 4700 Ω resistor.
- () Refer to Pictorial 4-8 and interconnect your equipment. Make sure you use RG-58A/U, RG-8A/U, or similar 50 Ω coaxial cable for all leads which carry RF.
- () Plug the power line connectors together.



PICTORIAL 4-6

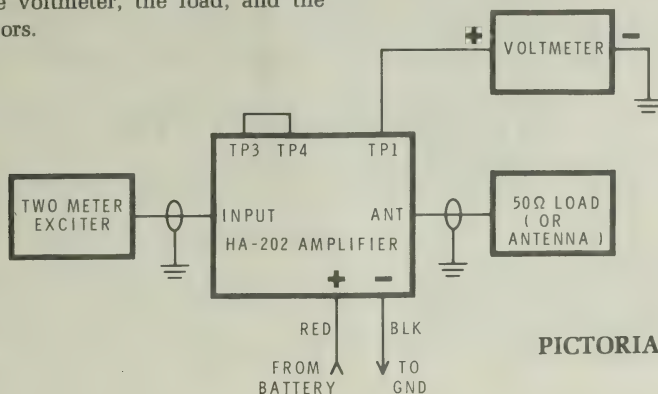


PICTORIAL 4-7

NOTE: When you adjust trimmer capacitor C1 in the following steps, it will tune broadly.

- () 1. While you key the exciter 5 seconds on and 10 seconds off, use the alignment tool constructed earlier to adjust capacitors C2, C15, and C16 (see Pictorial 4-5) in the sequence listed for maximum meter indication. Proper tuning is indicated when the voltage at TP1 is at least twice the voltage shown on the meter when the + power wire is disconnected.
- () 2. Readjust capacitors C1, C2, C15, and C16 in the sequence listed for maximum meter indication.
- () 3. Adjust capacitor C1 slowly clockwise, then counterclockwise, while you observe the meter to determine when output power starts to decrease. Then set capacitor C1 to the middle of this range.
- () Disconnect the voltmeter, the load, and the power connectors.
- () Unsolder and remove the U-shaped connector that you earlier placed in connector pins TP3 and TP4.
- () Unsolder and remove the 4700 Ω resistor. Also, remove the 2.7 pF capacitor with clips and save the assembly for possible future use.
- () C18: Cut the leads of the remaining 2.7 pF ceramic capacitor to 1/4". Then place the capacitor lead ends in the connector pins inside the outline for the 2.7 pF capacitor on the circuit board. See Pictorial 4-7. Solder both leads to the connector pins.
- () Cut a capacitor lead (laid aside earlier) to 5/8". Bend the ends down to form a U-shaped connector. Place the ends in connector pins TP1 (S-1) and TP2 (S-1).

This completes the alignment. Proceed to "Final Assembly."



PICTORIAL 4-8



FINAL ASSEMBLY

- () Refer to Pictorial 5-1 and place the cover on the Amplifier. Secure the cover with four #6 \times 3/8" sheet metal screws, a 1/4" cable clamp, and a "D" washer. Position the two power leads under the cable clamp. On the opposite side, use four #6 \times 3/8" sheet metal screws.

NOTE: The blue and white label that you will install in the following step shows the Model number and Production Series number of your kit. Refer to these numbers in any communications you have with the Heath Company about this kit.

- () Carefully peel away the paper backing from the blue and white label. Then press the label onto the cover as shown in Pictorial 5-1.
- () Locate the four rubber feet. Then press a rubber foot into each of the four holes in the cover as shown in the Pictorial.

NOTE: If it is ever necessary to realign your Amplifier, first remove the four rubber feet from the cover. Then refer to the "Alignment" section of this Manual and adjust the trimmer capacitors which are now accessible through the four holes in the cover. After you have completed the alignment, reinstall the rubber feet.

- () Secure the Amplifier in its final position with four #10 \times 3/8" sheet metal screws in the holes previously drilled.
- () Attach the input and antenna coaxial cables.
- () If not already done, connect the free end of the black power wire to the selected ground point.
- () Plug the power line connectors together.

This completes the "Installation and Alignment." Proceed to the "Operation" section.

OPERATION

GENERAL

Operation of this Amplifier is entirely automatic. When the exciter is keyed, the amplifier relay will transfer the exciter output to the amplifier input circuits, and the amplifier output to the antenna. In the receive mode, the relay connects the exciter via a low-pass filter to the antenna. Current drain in the receiver mode is negligible (below one mA).

POWER SUPPLY

A DC voltage between 12.6 volts and 16 volts will operate the Amplifier. The voltage can be furnished

by an AC-operated power supply or a 12-volt system, such as an automobile battery. The supply must have a negative ground and be capable of at least 7 amperes output. For fixed station use, the Heathkit Model HP/PS-1175 will sufficiently power this Amplifier at normal line voltages. This power supply also has sufficient reserve to power most exciters (about 3 amperes).

CAUTION: Before you connect this Amplifier to a mobile "12-volt" power source, check the voltage at the battery with the engine running above a fast idle. The voltage MUST NOT exceed 16 volts or the Amplifier may be damaged.

IN CASE OF DIFFICULTY

1. Make sure there are from 12 to 16 volts present at the terminal strip.
2. The majority of the kits that are returned for repair do not function properly due to poor connections and soldering. Many troubles can be eliminated by carefully reheating all connections to make sure that they are soldered as described in the Soldering section on Page 9 of this Manual.
3. Check the values of the parts installed. Be sure that the proper part has been wired into the circuit for each step as shown in the Pictorial diagrams.



4. Recheck the wiring. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something consistently overlooked by the builder.
5. Check for bits of solder, wire ends, or other foreign matter which may be lodged in the wiring.
6. Make sure all excess lead lengths have been clipped from the foil side of the circuit board. Unclipped leads could cause a short circuit from the circuit board to the chassis.
7. A review of the Circuit Description may prove helpful in indicating where to look for trouble.
8. In an extreme case where you are unable to resolve a difficulty, refer to the "Customer Service" information inside the rear cover of the Manual. Your Warranty is located inside the front cover.
9. When a component (Q1, C2, R3, etc.) is mentioned in the "Possible Cause" column of the "Troubleshooting Chart," check that specific component to make sure it operates properly, together with those parts connected to it. Refer to the X-Ray View for the physical location of parts on the circuit board.

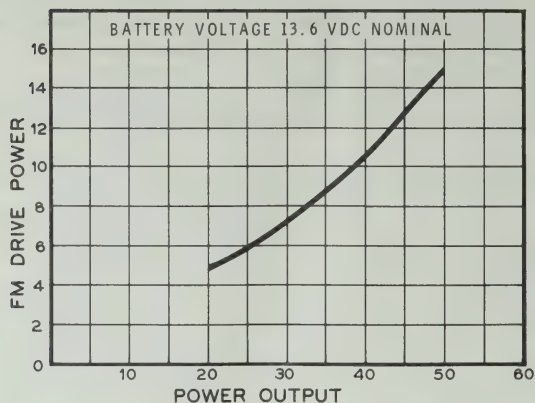
Troubleshooting Chart

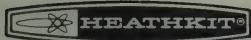
SYMPTOM	POSSIBLE CAUSE
Fuse blows when installed.	<ol style="list-style-type: none"> 1. Power leads reversed at Amplifier. 2. C11, C12, C13, C14, C15, or C25. 3. Q1 or Q2. 4. Red power wire shorted to automobile body during installation.
Fuse blows when Amplifier is keyed.	<ol style="list-style-type: none"> 1. Amplifier mistuned. 2. Antenna VSWR excessive. 3. Relay contacts not closing properly. 4. Coaxial cable shorted from center conductor to braid.
Output power is low.	<ol style="list-style-type: none"> 1. Drive power is low. 2. Amplifier mistuned. 3. Relay contacts misaligned. 4. Relay improperly wired. 5. Antenna VSWR excessive. 6. Q1 or Q2.
Relay will not pull in.	<ol style="list-style-type: none"> 1. Drive is low. 2. D1, C18, Q3. 3. TP1 and TP 2 not connected together or C18 not connected. 4. Relay (to check relay, jumper TP3 to TP4; relay should pull in). 5. Fuse blown. 6. Input and antenna connections reversed.
Relay pulls in, when battery is connected.	<ol style="list-style-type: none"> 1. Q3 or D2. 2. TP3 and TP4 jumper not removed after alignment.
C1, C2, C15 or C16 will not peak (capacitors fully open or compressed).	<ol style="list-style-type: none"> 1. L1 and L9 incorrect. 2. Antenna VSWR excessive.
Received signals weak with Amplifier in line.	<ol style="list-style-type: none"> 1. Relay contacts not operating properly. 2. Relay wired incorrectly. 3. Amplifier mistuned. (Low frequency oscillation will cause the received signal to sound noisy, or weak.)

SPECIFICATIONS

Frequency Range	143 to 149 MHz (any 1-1/2 MHz segment).
Power Output	See the graph below.
Power Input (drive power required)	5 to 15 watts FM signal.
Input/Output Impedance	50 ohms.
Input VSWR	1.5:1 maximum.
Maximum Stable VSWR	3:1 maximum.
Harmonic and Spurious Radiation	-60 dB or better.
Power Supply Required	12 to 16 VDC, 7 Amperes maximum, negative ground.
Standby Current	1 mA.
Operating Temperature Range	-30°F to +140°F.
Dimensions	3" high × 5-1/2" deep × 4-1/4" wide (excluding mounting flanges).
Weight	2 lbs.

The Heath Company reserves the right to discontinue products and to change specifications at any time without incurring any obligation to incorporate new features in products previously sold.





CIRCUIT DESCRIPTION

The 50 ohm amplifier input impedance is transformed to approximately 5 ohms by C1, C2 and L1. The driving power is then split to drive the two amplifier transistors (Q1 and Q2). C3, L2, C4, C5 and C6 match the base of Q1 to the 5 ohm summing point impedance, and C3, L3, C7, C8 and C9 perform this function for Q2. Three capacitors are used at each base for better current distribution and lower loss. R4 at the summing point provides a DC return for the bases of Q1 and Q2. Resistors R1 and R2 prevent spurious oscillations.

The collector output impedance of Q1 is matched to the 5 ohm impedance of the output summing point by L5, C12, C13, and C14. Similarly, Q2 is matched by L6, C12, C13, and C14. The 5 ohm summing point impedance is transformed to 50 ohms at the amplifier output by L8, C15, and C16.

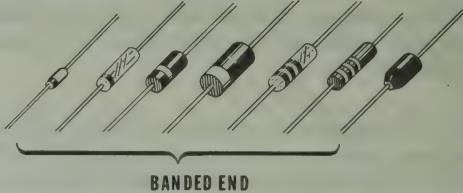
C11 and C25 form a circuit that isolates the RF voltage at the collectors of the amplifier transistors from the

power supply. This circuit provides a ground for all low-frequency parasitics.

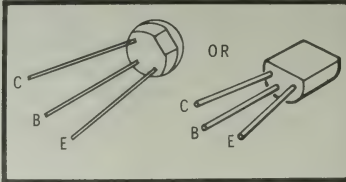
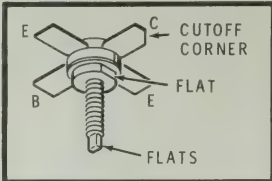
A portion of the input signal is sampled by C18, detected by D1, and filtered by L9, R3, and C17. The resulting DC voltage is used to drive transistor Q3 into conduction. This causes relay RL1 to energize and close. When closed, the relay connects the Input socket to the amplifier input and the amplifier output signal is passed through the low-pass filter to the Antenna socket. The low-pass filter, comprised of C22 through C24 and L11 through L14, attenuates harmonic emissions in the transmit mode. When relay RL1 is de-energized, the low-pass filter helps attenuate received signals that are above the 2-meter band. The filter also helps reduce harmonic emissions from the exciter. The incoming signals pass from the Antenna socket, through the low-pass filter, via the relay contacts to the input of the receiver stage. Diode D2 protects Q3 from the transient developed by the relay when it is switched off.

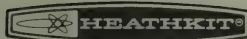
SEMICONDUCTOR IDENTIFICATION CHART

DIODES

CIRCUIT COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
D1, D2	56-56	1N4149	<p>IMPORTANT: THE BANDED END OF DIODES CAN BE MARKED IN A NUMBER OF WAYS.</p> 

TRANSISTORS

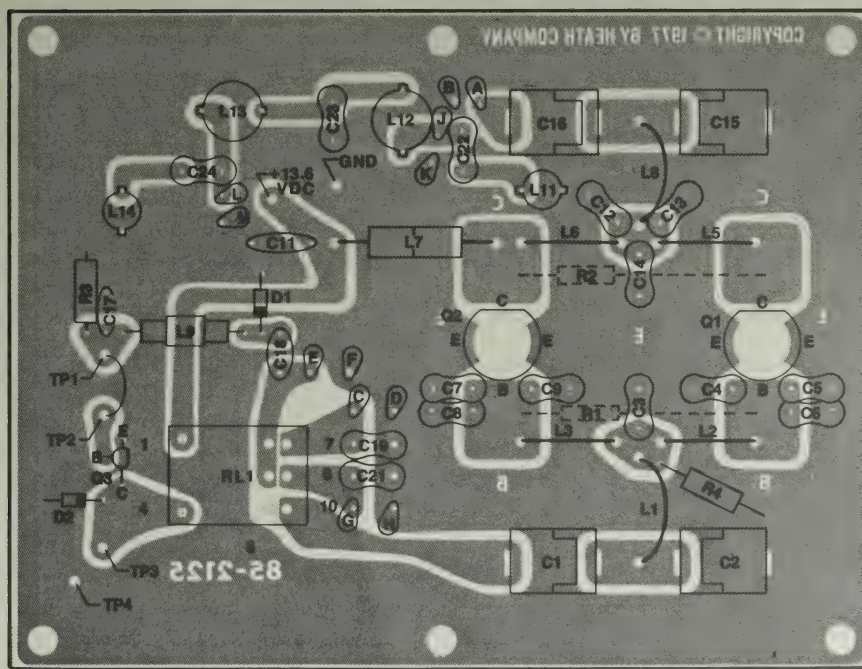
CIRCUIT COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
Q3	417-155	2N3641	
Q1, Q2	417-299	2N5591 or B25-12	



CIRCUIT BOARD X-RAY VIEW

NOTE: To find the PART NUMBER of a component for the purpose of ordering a replacement part:

- A. Find the circuit component number (R5, C3, etc.) on the "X-Ray View."
- B. Locate the same number in the "Circuit Component Number" column of the "Parts List" in the front of this Manual.
- C. Adjacent to the circuit component number, you will find the PART NUMBER and DESCRIPTION which must be supplied when you order a replacement part.



(Viewed from lettered side)

FOR PARTS REQUESTS ONLY

- Be sure to follow instructions carefully.
- Use a separate letter for all correspondence.
- Please allow 10 - 14 days for mail delivery time.

DO NOT WRITE IN THIS SPACE**INSTRUCTIONS**

- Please print all information requested.
- Be sure you list the correct **HEATH** part number exactly as it appears in the parts list.
- If you wish to prepay your order, mail this card and your payment in an envelope. Be sure to include 10% (25¢ minimum, \$3.50 maximum) for insurance, shipping and handling. Michigan residents add 4% tax.

Total enclosed \$ _____

- If you prefer COD shipment, check the COD box and mail this card. COD ☐

NAME _____

ADDRESS _____

CITY _____

STATE _____ ZIP _____

The information requested in the next two lines is not required when purchasing nonwarranty replacement parts, but it can help us provide you with better products in the future.

Model # _____ Invoice # _____

Date _____ Location _____

Purchased _____ Purchased _____

LIST **HEATH**
PART NUMBER

QTY.

PRICE
EACHTOTAL
PRICE

TOTAL FOR PARTS

HANDLING AND SHIPPING

MICHIGAN RESIDENTS ADD 4% TAX

TOTAL AMOUNT OF ORDER

SEND TO: **HEATH COMPANY**
BENTON HARBOR
MICHIGAN 49022
ATTN: PARTS REPLACEMENT

Phone (Replacement parts only): 616 982-3571

THIS FORM IS FOR U.S. CUSTOMERS ONLY
OVERSEAS CUSTOMERS SEE YOUR DISTRIBUTOR

FOR PARTS REQUESTS ONLY

- Be sure to follow instructions carefully.
- Use a separate letter for all correspondence.
- Please allow 10 - 14 days for mail delivery time.

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Total enclosed \$ _____

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LIST **HEATH**
PART NUMBER

QTY.

PRICE
EACHTOTAL
PRICE

TOTAL FOR PARTS

HANDLING AND SHIPPING

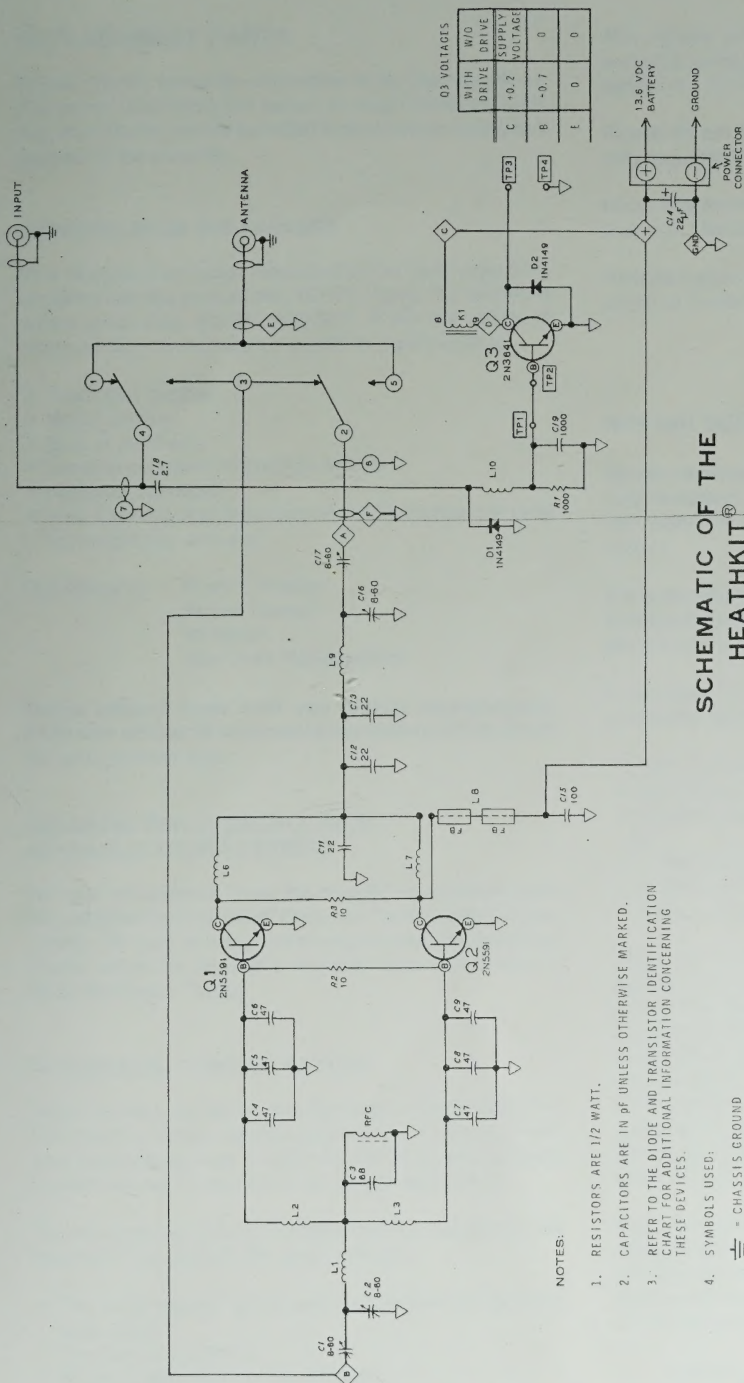
MICHIGAN RESIDENTS ADD 4% TAX

TOTAL AMOUNT OF ORDER

SEND TO: **HEATH COMPANY**
BENTON HARBOR
MICHIGAN 49022
ATTN: PARTS REPLACEMENT

Phone (Replacement parts only): 616 982-3571

THIS FORM IS FOR U.S. CUSTOMERS ONLY
OVERSEAS CUSTOMERS SEE YOUR DISTRIBUTOR



SCHEMATIC OF THE HEATHKIT® 2-METER FM AMPLIFIER MODEL HA-202

NOTES:

1. RESISTORS ARE 1/2 WATT.
2. CAPACITORS ARE IN pF UNLESS OTHERWISE MARKED.
3. REFER TO THE DIODE AND TRANSISTOR IDENTIFICATION CHART FOR ADDITIONAL INFORMATION CONCERNING THESE DEVICES.
4. SYMBOLS USED:

- ⊞ = CHASSIS GROUND
- ▽ = CIRCUIT BOARD GROUND
- = RELAY TERMINAL
- ◇ = CIRCUIT BOARD CONNECTION
- = TERMINAL STRIP CONNECTION
- ⊞ = FERRITE BEAD

CUSTOMER SERVICE

REPLACEMENT PARTS

Please provide complete information when you request replacements from either the factory or Heath Electronic Centers. Be certain to include the **HEATH** part number exactly as it appears in the parts list.

ORDERING FROM THE FACTORY

Print all of the information requested on the parts order form furnished with this product and mail it to Heath. For telephone orders (parts only) dial 616 982-3571. If you are unable to locate an order form, write us a letter or card including:

- Heath part number.
- Model number.
- Date of purchase.
- Location purchased or invoice number.
- Nature of the defect.
- Your payment or authorization for COD shipment of parts not covered by warranty.

Mail letters to: Heath Company
Benton Harbor
MI 49022
Attn: Parts Replacement

Retain original parts until you receive replacements. Parts that should be returned to the factory will be listed on your packing slip.

OBTAINING REPLACEMENTS FROM HEATH ELECTRONIC CENTERS

For your convenience, "over the counter" replacement parts are available from the Heath Electronic Centers listed in your catalog. Be sure to bring in the original part and purchase invoice when you request a warranty replacement from a Heath Electronic Center.

TECHNICAL CONSULTATION

Need help with your kit? — Self-Service? — Construction? — Operation? — Call or write for assistance. you'll find our Technical Consultants eager to help with just about any technical problem except "customizing" for unique applications.

The effectiveness of our consultation service depends on the information you furnish. Be sure to tell us:

- The Model number and Series number from the blue and white label.
- The date of purchase.
- An exact description of the difficulty.
- Everything you have done in attempting to correct the problem.

Also include switch positions, connections to other units, operating procedures, voltage readings, and any other information you think might be helpful.

Please do not send parts for testing, unless this is specifically requested by our Consultants.

Hints: Telephone traffic is lightest at midweek — please be sure your Manual and notes are on hand when you call.

Heathkit Electronic Center facilities are also available for telephone or "walk-in" personal assistance.

REPAIR SERVICE

Service facilities are available, if they are needed, to repair your completed kit. (Kits that have been modified, soldered with paste flux or acid core solder, cannot be accepted for repair.)

If it is convenient, personally deliver your kit to a Heathkit Electronic Center. For warranty parts replacement, supply a copy of the invoice or sales slip.

If you prefer to ship your kit to the factory, attach a letter containing the following information directly to the unit:

- Your name and address.
- Date of purchase and invoice number.
- Copies of all correspondence relevant to the service of the kit.
- A brief description of the difficulty.
- Authorization to return your kit COD for the service and shipping charges. (This will reduce the possibility of delay.)

Check the equipment to see that all screws and parts are secured. (Do not include any wooden cabinets or color television picture tubes, as these are easily damaged in shipment. Do not include the kit Manual.) Place the equipment in a strong carton with at least **THREE INCHES** of *resilient* packing material (shredded paper, excelsior, etc.) on all sides. Use additional packing material where there are protrusions (control sticks, large knobs, etc.). If the unit weighs over 15 lbs., place this carton in another one with 3/4" of packing material between the two.

Seal the carton with reinforced gummed tape, tie it with a strong cord, and mark it "Fragile" on at least two sides. Remember, the carrier will not accept liability for shipping damage if the unit is insufficiently packed. Ship by prepaid express, United Parcel Service, or insured Parcel Post to:

Heath Company
Service Department
Benton Harbor, Michigan 49022



W4GRX
HUBERT C. JONES, JR.
2205 ROCKBRIDGE RD NW
CONYERS GA 30012-3440

HEATH COMPANY • BENTON HARBOR, MICHIGAN
THE WORLD'S FINEST ELECTRONIC EQUIPMENT IN KIT FORM

LITHO IN U.S.A.